

California Pest Rating Proposal for

Xanthomonas euvesicatoria pv. *alfalfae* (Riker et al.) Constantin et al. 2016
= *Xanthomonas alfalfae* (Riker et al.) Dowson

Bacterial leaf spot of lucerne

Current Pest Rating: none

Proposed Pest Rating: B

Kingdom: Bacteria, Phylum: Proteobacteria,
Class: Gammaproteobacteria, Order: Lysobacterales,
Family: Lysobacteraceae

Comment Period: 01/24/2023 through 03/10/2023

Initiating Event:

This pathogen has not been through the current pest rating process. The risk to California from *Xanthomonas euvesicatoria* pv. *alfalfae* is described herein and a permanent rating is proposed.

History & Status:

Background:

Alfalfa is an exceptional perennial forage legume in California due to its combination of high quality, high yield, biological nitrogen fixation, and soil benefits. It provides high energy and protein as feed for dairy cows and cattle, horses, goats, and sheep. Alfalfa is the state's highest acreage crop and California leads the nation in alfalfa hay production. Alfalfa is an important component in the production of dairy products which are California's largest agricultural commodity. Alfalfa hay and seeds are important agricultural exports

https://www.cdfa.ca.gov/Statistics/PDFs/2021_Ag_Stats_Review.pdf.

Alfalfa was domesticated 4000 years ago near present day Turkmenistan, Iran, Turkey, and the Caucasus. The name has Arabic and Persian origins and means "best horse fodder." In Europe it is called "lucerne." Alfalfa has been grown in California since the mid-1800s, its introduction and expansion paralleling the effect of the Gold Rush which brought great expansion to California

agriculture. Today alfalfa is produced throughout California, but the major growing areas are the Sacramento and San Joaquin valleys, followed by the Imperial and Palo Verde valleys in the low desert, the high desert region north and east of the Los Angeles basin, and in temperate high-elevation intermountain regions. Growers in the low desert can harvest up to 12 times per year, with a statewide average of 6-7 harvests per year. Alfalfa stands are kept an average 3 to 4 years, and grown in rotation with wheat, corn, cotton, sugar beets, and processing tomatoes. Nearly 100% of alfalfa is irrigated, and water availability is the largest yield-limiting factor. Alfalfa consumes more irrigation water than any other crop, accounting for nearly 20% of the state's water use. On the other hand, it is also relatively water-use efficient, producing more dry matter per unit of irrigation than many other commodities. California is also the leading alfalfa seed producer with concentrations in Fresno and Imperial counties. Seed is exported worldwide (Summers and Putnam, 2008).

Bacterial leaf spot of lucerne was first detected in Wisconsin in 1930 (Riker et al., 1935). The type strain of the pathogen was isolated in India in 1954. Classification of species within the genus *Xanthomonas* underwent major revision based on nucleic acid analysis. A comprehensive DNA-DNA hybridization study recognized 20 species (Vauterin et al., 1995). Jones et al. (2004) reported that the bacterial spot-causing xanthomonads (BSX) could be reclassified as four species—*X. euvesicatoria*, *X. vesicatoria*, *X. perforans*, and *X. gardneri*. *Xanthomonas euvesicatoria* can be differentiated from the phylogenetically related *Xanthomonas* species by multi locus sequence analysis. The correct identification of the bacterial spot pathogens is important for plant quarantine, disease management, and breeding for resistance.

Although serious economic losses due to bacterial leaf spot have rarely been reported, *X. euvesicatoria* pv. *alfalfae* has the potential to cause significant crop losses in the presence of favorable environmental conditions such as high relative humidity, high precipitation, and sprinkler irrigation. These factors, along with overhead irrigation accompanied by high temperature and high plant density create an ideal environment for disease development and spread. It has been demonstrated that even a low incidence of bacterial leaf spot in the field can introduce severe epidemics when these environmental conditions are present (Samac et al., 2015). As a seedborne pathogen, *X. euvesicatoria* pv. *alfalfae* is included in the EPPO's A2 (high risk) list of quarantine pathogens by some countries; hence, it is under strict quarantine control and zero tolerance. It is a target of CDFA's field inspections for alfalfa seed crops (<https://www.cdfa.ca.gov/plant/pe/nsc/docs/seed/CPTM-PhytopsanitaryFieldInspectionCropLists.pdf>).

Hosts: Alfalfa (*Medicago sativa*) is the main host of *X. euvesicatoria* pv. *alfalfae*, and several other leguminous crops have been reported as hosts of the pathogen (Bradbury, 1981). *Glycine max* (soybean), *Lablab purpureus* (hyacinth bean), *M. scutellata* (snail medic), *M. trunculata* (barrel medic), *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Trifolium incarnatum* (Crimson clover), *T. pratense* (red clover), *T. resupinatum* (Shaftal clover), *Vicia benghalensis* (purple vetch,) *V. faba* (faba bean), *V. sativa* (common vetch), *Vigna mungo* (black gram), *V. radiata* (mung bean) (Osdaghi, 2020).

Symptoms: Small, water-soaked lesions are the main symptoms of bacterial leaf spot. Foliar symptoms initially appear as circular, 0.5–1 mm in diameter, water-soaked patches, surrounded by a diffuse

chlorotic area, which then turns dry, yellow-brown, and papery. Over time, the spots enlarge and cluster together to produce patches of dead tissue, particularly near the midrib and the ends of the leaflets. The necrotic portion of the spots can grow to be 2-3 mm in diameter with a dark-brown border surrounded by a chlorotic halo. In severe infections, the leaflets are nearly completely dried, accompanied by severe defoliation. Smaller lesions appear as dark brown patches. Other symptoms include seedling stunting, damage to alfalfa stands, and post-emergence damping off. Stem lesions, wilting, and vascular symptoms can be seen on inoculated plants, but are rarely observed in natural infections plants (Samac et al., 2015).

Transmission: Infected seeds are the main source of inoculum in areas with no history of the disease. However, the percentage of seed transmission and the longevity of the pathogen in infected seeds has not been investigated (Samac et al., 2015). Local and long-distance dispersal of the pathogen can occur through infested plant tissues and transportation of infested forage, with wind, wind-blown rain, rain splash and running water, and wind-driven soil. Sprinkler irrigation can also spread the pathogen (Clafin et al. 1973).

Damage Potential: Economic losses due to bacterial leaf spot have rarely been reported in the alfalfa industry, but *X. euvesicatoria* pv. *alfalfae* has the potential to cause significant crop losses in the presence of favorable environmental conditions such as high relative humidity, high precipitation, and sprinkler irrigation (Osdaghi, 2020). *Xanthomonas euvesicatoria* pv. *alfalfae* is reported to be seedborne in alfalfa (Jacques et al., 2013). However, the percentage transmission of the pathogen into offspring plants and the ability of infected seeds to produce viable plants have not been investigated (Bradbury, 1981).

Worldwide Distribution: Africa: *Egypt, Sudan*. Asia: *India, Syria*. Europe: *Georgia, Romania*. America: *El Salvador, United States* (Florida, Iowa, Kansas, Maryland, Wisconsin). Oceania: *Australia* (CABI, 2023).

Official Control: *Xanthomonas euvesicatoria* pv. *alfalfae* is on the EPPO's A2 list for Bahrain and a quarantine pest in Mexico, and *Xanthomonas euvesicatoria* is on the USDA's Harmful Organism list for the European Union, Morocco, and the United Kingdom.

California Distribution: None

California Interceptions: None

The risk *Xanthomonas euvesicatoria* pv. *alfalfae* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This disease has been reported in a variety of climates including temperate and tropical locations and susceptible hosts are widely cultivated in the state or are widely occurring weeds.
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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 legumes, but *Xanthomonas euvesicatoria* pv. *alfalfae* affects multiple legume species.

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:** Xanthomonads can reproduce at a nearly exponential rate under ideal environmental conditions. This pathogen is highly dependent on water to reproduce and spread, and epidemics can occur with sprinkler irrigation.

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:** This disease is mainly an issue for seed exporters. The impact in production fields is generally below the threshold for treatment, but seed lots can be rejected if this pathogen is detected by seed wash or field inspection of mother plants.

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

Economic Impact: A, B, C, G

- 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.
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- High (3) causes 3 or more of these impacts.

- 5) **Environmental Impact:** This disease impacts cultural practices and sprinkler irrigation should be minimized and foliage allowed to dry. Seed treatments may be used but they can lower germination rates.

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 *Xanthomonas euvesicatoria* pv. *alfalfae*: 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.

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.
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-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 = 12*

Uncertainty:

Xanthomonas euvesicatoria pv. *alfalfae* is morphologically and phenotypically similar to the other xanthomonads capable of infecting leguminous crops, i.e., *X. axonopodis* pv. *phaseoli* [*X. phaseoli* pv. *phaseoli*] and *X. axonopodis* pv. *glycines*. These species and pathovars are indistinguishable on general culture media and using routine biochemical tests. Diagnosis requires DNA sequence analysis to be done by a qualified phyto bacteriologist.

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for *Xanthomonas euvesicatoria* pv. *alfalfa* is B.

References:

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USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report. *Xanthomonas euvesicatoria*. Accessed 1/5/2023

Responsible Party:

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***Comment Period: 01/24/2023 through 03/10/2023**

*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).

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:
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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
