CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Erwinia aphidicola Harada et al., 1997

Pest Rating: C

Comment Period: 05/24/2023 through 07/08/2023

Initiating Event:

On September 5, 2017, a melon (*Cucumis melo* cv. *mlada*) fruit, showing symptoms of spotting and scabbing, was collected during a phytosanitary field inspection in Glenn County, by Glenn Agricultural County officials and sent to the CDFA Plant Pathology Laboratory for diagnoses. Sebastian Albu, CDFA plant pathologist, identified the bacterium, *Erwinia aphidicola*, from the exterior surface of the melon sample by PCR and DNA sequencing. As there have been no earlier reports in the USA, a culture was sent to the USDA APHIS PPQ CPHST Diagnostic Lab in Beltsville, Maryland, for diagnostic confirmation. On November 20, 2017, the USDA confirmed the identity of *E. aphidicola* and marked a new record in the U.S. (USDA, 2017). The bacterium was assigned a temporary 'Q' rating.

The risk of introduction and establishment of this bacterial pathogen was assessed, and following a 45-day comment period, a B-rating was finalized on November 29, 2017. Since then, multiple detections have been made on various hosts in seven additional counties covering multiple climatic zones. This proposal is to change the rating from a B to a C.

History & Status:

Background:

Erwinia aphidicola (Enterobacteriaceae) was originally discovered as a new bacterial species constituting the major gut flora of the pea aphid, *Acyrthosiphon pisum*, and caused aphid mortality (Harada et al., 1997). In 2009, *E. aphidicola* was confirmed as a plant pathogen (Santos et al., 2009) causing diseases of common bean and pea in southeastern Spain. At These diseases were previously attributed to a different bacterial species, *E. persicina* (González et al., 2005, 2007; Santos et al., 2009). Both *E. persicina* and *E. aphidicola* are closely related species that show high similarity (99-100%) in 16S rDNA sequence analysis. However, Santos et al., (2009) confirmed that sequence analysis of 16S

rDNA may not provide sufficient resolving power to discriminate these closely related species, but would require a more species-specific set of DNA primers for PCR amplification. Subsequently, Santos and others were able to molecularly discriminate *E. aphidicola* from *E. persicina* and show that *E. aphidicola* was the cause of the related diseases reported from Spain.

Erwinia aphidicola had not been reported in the USA prior to its 2017 detection in California. However, another bacterial species, *E. nulandii,* was isolated from bean in 1981 in Nebraska and was shown to be distinct from all other *Erwinia* species by biochemical, protein, and DNA analytical tests (Schuster et al., 1981). In 1994, *E. nulandii* was determined to be a synonym of *E. persicinus* (later corrected to *E. persicina*) – the species that is closely related to *E. aphidicola* (Brenner et al., 1994). As shown by Santos and others (2009), further sequence analysis of the USA isolate of *E. persicina* may be necessary to distinguish the possible presence of *E. aphidicola*.

Hosts: Published in literature, *Phaseolus vulgaris* (bean), *Pisum sativum* (pea) *Hordeum vulgare* (barley), *Capsicum annuum* (pepper) are reported as natural hosts for *Erwinia aphidicola* (Santos et al., 2009; Kawaguchi et al., 2021; Luo et al., 2018). Experimentally, cucumber, tomato, pepper, and melon were reported as alternative hosts to green bean for the southeastern Spanish isolate of *E. persicina* (Diánez et al., 2009) which was later identified as *E. aphidicola* (Marín et al., 2011). California detections since 2017 have been from melon, alfalfa, onion, lettuce, sunflower, Sudan grass, cauliflower, watermelon, and pepper (CDFA PDR Database, 2023).

Symptoms: Symptoms of chlorotic and necrotic leaf spots in beans and generalized chlorosis as well as necrosis in leaves and tendrils in peas are exhibited when these plants are infected with *Erwinia aphidicola* (González et al., 2005, 2007). In beans, early symptoms of light, interveinal chlorosis in leaves soon turn into yellowish leaves with green veins. As the disease progresses, necrotic spots develop and completely affected leaves turn brown. Watery spots appear on infected pods, which take on a curved, hook-like appearance. Rough roots along the entire stem are also produced in diseased plants (Marín et al., 2011). Marín and other researchers (2011) observed 13 different symptoms in plants grown from commercial bean seeds and 10 different symptoms in plants grown from replanting bean seeds in a controlled environment bioassay study. Those symptoms included the earlier reported ones in varying intensities, as well as green wilted and deformed leaves and dwarfed plants.

In experimental trials, tomato, pepper, cucumber, and melon inoculated with *E. aphidicola*, exhibited symptoms of leaf necrosis, adventitious roots, brown coloration along the stem, interveinal chlorosis, curled, and blistered leaves. In cucurbits, a distinct lesion in some areas of the stem was also exhibited (Diánez et al., 2009). On field grown peppers, the symptoms appeared as small circular to irregular shaped, brown to black necrotic spots on the fruit surface. The lesions developed rapidly into soft rot, and fruits dropped within 5 to 7 days (Luo et al., 2018).

In California, symptoms of reticulate scabbing with irregular cracks within scabs, and scattered chlorotic spots were observed on the *E. aphidicola*-infected melon fruit (see 'Initiating Event'). These symptoms covered most of the surface of the fruit and were not apparent in internal tissue (personal

communication: Sebastian Albu, CDFA). However, pathogenicity tests were not conducted, therefore these symptoms cannot be definitively linked to this bacterium.

Transmission: While there is no information reported on the pathogenesis and epidemiology of disease caused by *Erwinia aphidicola*, it is likely that the biology of *E. aphidicola* is similar to its closely relative, *E. persicina*, for which only scant information is available. In greenhouse studies on the life cycle, host range, and environmental effects of *E. persicina* infecting forage or grain legumes, including bean and pea, Zhang and Nan (2014) determined that the pathogen was transmitted by seeds, water, and soil. It was present both on the surface and within seeds. Bacteria present on seeds can be internalized within the sprout and become protected from post-harvest sanitation. Bacteria within seeds can remain alive indefinitely thereby, facilitating long distance transmission of the pathogen via movement of seeds. The pathogen was capable of surviving in alfalfa soil for more than three months and could invade alfalfa plants through natural openings. Once within a plant, the bacterial pathogen can move from the roots upward to the leaves, inflorescences, and subsequently, the seeds. The pathogen is capable of surviving within a wide range of environmental conditions and can endure arid, saline, and alkaline conditions. The optimum temperature for growth was 28°C within a range of 10-36°C and no growth occurred below 5°C or above 40°C (Zhang & Nan, 2014). The disease is spread with pathogen-infested plants, seeds, soil, and water (Zhang & Nan, 2014).

Damage Potential: In southeastern Spain, *Erwinia aphidicola* is reported to have caused over 50% decrease in production of commercial beans due to chlorotic and necrotic leaf spotting and deformation of pods (González et al., 2005). The disease affected approximately 12 ha of field-grown peas (González et al., 2007). Like southeastern Spain, most of California experiences a Mediterranean climate, which is usually characterized by rainy winters and dry, warm to hot summers. Beans and peas are commercially cultivated in such climate in limited regions within the State and may be at risk of disease caused by *E. aphidicola*.

Worldwide Distribution: Europe: Spain; North America: USA (California) (Marin et al., 2011).

Official Control: Presently, *Erwinia aphidicola* has a B rating in California. No official control has reported by any country for *E. aphidicola.*

California Distribution: Fresno, Glenn, Imperial, Solano, San Joaquin, Santa Barbara, and Yolo counties (PDR Database, 2023).

California Interceptions: None reported.

The risk would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Erwinia aphidicola* is likely to establish in limited parts of California wherever its natural hosts, peas and beans are grown. Its current detection in melon fruit indicates the

possible inclusion of an additional host in California. It is capable of surviving under a wide range of environmental conditions.

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 establish in a larger but limited part of California.**
- High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** Initial detections were from peas and beans but more hosts have been reported from multiple families.

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:** The bacterial pathogen has high reproduction and is spread by artificial means through infected planting stock, seeds, soil, and water.

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:** The potential impact of the pathogen on crop production could result in lowered crop yield and value, as well as a loss of marketability of pea and bean pods.

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

Economic Impact: A

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:** No impact to the environment is expected.

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

Environmental Impact:

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: 1
- 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 *Erwinia aphidicola:* 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 'medium'.

Score: -2
-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* ***= 8***

Uncertainty:

The host range of *Erwinia aphidicola*, its epidemiology, and damage caused to those hosts is not fully known.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Erwinia aphidicola* is C.

References:

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USDA. 2017. Email from J. H. Bower, USDA APHIS, to S. Brown, CDFA, (and others). Subject: Fw: Positive: two (2) samples for *Erwinia aphidicola* from CA (new U.S. record). Sent: Monday, November 20, 2017, 10:42 am.

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Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, permits[@]cdfa.ca.gov.

***Comment Period: 05/24/2023 through 07/08/2023**

***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.

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: C