CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pseudomonas syringae pv. *lachrymans* (Smith & Bryan 1915) Young et al. 1978

Cucurbit angular leafspot

Current Pest Rating: B

Proposed Pest Rating: B

Domain: Bacteria; Phylum: Proteobacteria

Class: Gammaproteobacteria; Order: Pseudomonadales

Family: Pseudomonadaceae

Comment Period: 7/21/2020 through 9/4/2020

Initiating Event:

On August 9, 2019, USDA-APHIS published a list of "Native and Naturalized Plant Pests Permitted by Regulation". Interstate movement of these plant pests is no longer federally regulated within the 48 contiguous United States. There are 49 plant pathogens (bacteria, fungi, viruses, and nematodes) on this list. California may choose to continue to regulate movement of some or all these pathogens into and within the state. In order to assess the needs and potential requirements to issue a state permit, a formal risk analysis for *Pseudomonas syringae* pv. *lachrymans* is given herein and a permanent pest rating is proposed.

History & Status:

Background: Within the bacterial genus *Pseudomonas*, certain pathogens of lilac have long been identified as the '*P. syringae* complex' based on metabolic tests and pathogenicity. DNA-DNA hybridization studies and multilocus sequence analyses indicate that the *P. syringae* complex holds up to ten *Pseudomonas* species and 60 pathovars. *Pseudomonas syringae* pv. *lachrymans* was established by Young et al. (1978) based mainly on its ability to cause angular leaf spot and fruit rot on all species of cucurbits. It is one of the most serious diseases of cucumber worldwide.

Hosts: Benincasa hispida (wax gourd), *Citrullus lanatus* (watermelon), *Cucumis anguria* (West Indian gherkin), *Cucumis melo* (melon), *Cucumis sativus* (cucumber), *Cucurbita moschata* (pumpkin), *Cucurbita pepo* (pumpkin), *Luffa acutangula* (angled luffa), and *Sechium edule* (chayote).

Symptoms: *Pseudomonas syringae* pv. *lachrymans* affects aboveground parts of cucurbits including leaves, stems, vines, and fruits. Symptoms begin as small, angular or circular spots that are brown or straw-colored with a yellow halo. As the spots expand, they become large, angular to irregular, and water soaked. In wet weather, droplets of bacterial ooze can exude from the spots on the lower leaf surfaces. In dry weather the exudate becomes a whitish crust. Infected areas on leaves die and shrink, often tearing and falling off, leaving large, irregular-shaped holes in the leaves, which gives the disease its name. Infected fruits initially show small, circular, usually superficial spots. Affected tissues die, turn white, and crack open, which results in secondary colonization by fungi and other bacteria that enter and rot the entire plant. When the bacteria infect the fruit, they move deep into the tissue and infect the seed (Komoto and Kimura, 1983; Agrios, 2005; CABI-CPC, 2020).

Transmission: Bacteria can overwinter in infected plant refuse left in the field for up to two years, but the pathogen does not seem to be truly soilborne. Bacteria are splashed to cotyledons and leaves which they penetrate through stomata, hydathodes, and small wounds. They can move systemically to other parts of the plant. The pathogen can also survive on contaminated seed, where bacterial cells are under the seed coat. During germination, primary infections appear on the seedlings. When humidity is high, a drop of clear to white sticky bacterial ooze forms on infected tissues. This can be moved from plant to plant on the hands and tools of workers, by insects, or by splashing water (Davis et al., 2016; Agrios, 2005).

Damage Potential: Angular leaf spot thrives in warm humid conditions. Disease epidemics are favored by wet conditions and are associated with rainfall, high relative humidity, and a combination of warm, moist soil at night following warm days. Control is obtained through the use of clean or treated seed, resistant varieties, and crop rotation. Some level of damage to leaves is tolerable, but fruit infections and seed infections are not. Infection of young fruit may cause extensive fruit drop. Vines can sometimes grow away from older infected leaves, producing enough new growth to support normal fruit development. In severe infestations, the growing tips of cucumber vines can become systemically infected, become water-soaked and yellow, and stop growing (CABI-CPC, 2020).

Worldwide Distribution:

Africa: *Algeria, Egypt, Gabon, Kenya, South Africa,* and *Zimbabwe*. Asia: *China, India, Iran, Israel, Japan, Jordan, Kazakhstan, Laos, North Korea, Philippines, Singapore, South Korea, Tajikistan, Thailand, Turkey,* and *Uzbekistan*. Europe: *Austria, Belarus, Bulgaria, Czechia, Denmark, France, Germany, Greece, Hungary, Italy, Moldova, Netherlands, Poland, Romania, Russia, Slovakia, Switzerland, Ukraine,* and *United Kingdom.* North America: *Canada, Guadeloupe, Martinique, Mexico, Nicaragua, Puerto Rico, Trinidad and Tobago,* and *United States*. Oceania: *Australia* and *New Zealand.* South America: *Argentina, Brazil, Colombia,* and *Venezuela* (CABI-CPC, 2020; EPPO, 2020; Harighi, 2007).

Official Control: USDA harmful organism list for Argentina, Chile, Colombia, Ecuador, French Polynesia, Guadeloupe, Guatemala, India, Jordan, Martinique, Mexico, New Caledonia, Panama, Peru, Thailand, and Yemen (USDA-PCIT, 2020). Quarantine pest in Mexico, A1 list in Chile, A2 list in Bahrain and Jordan (EPPO, 2020). It is a pest of concern in the CDFA phytosanitary seed export program.

California Distribution: Detections have been made very occasionally over the last 50 years in Colusa, Monterey, San Diego, and Sutter counties. No detections have been made since 1991 (French, 1989; CDFA PDR Database), thus no isolates have been confirmed by none have undergone modern DNA sequencing and phylogenetic methods.

California Interceptions: None

The risk *Pseudomonas syringae* pv. *lachrymans* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The pathogen is present throughout the world and the disease is most serious in cucumbers grown in warm, humid and semi-humid regions. Disease epidemics occur under wet conditions from rainfall (or sprinklers), and high relative humidity. Most cucurbits are drip irrigated and in the central valley and desert where they are largely grown, conditions are generally hot and dry.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **1**
   - 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 cucurbits.

   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:** Bacterial pathogens under ideal conditions can reproduce at an exponential rate. They are spread by aerosols, rain, and sprinklers. Angular leaf spot is also spread through the movement of seed.

   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:** Angular leaf spot is one of the most widespread bacterial diseases of cucurbits. Early infection results in significant yield reduction in the number of fruits and fruit weight. Infected fields should be rotated away from cucurbits for 2-3 years. Seed infection can prevent phytosanitary certification and movement of seed to trading partners.

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

Economic Impact: A, B, C, and D

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:** Many resistant varieties are available for cucumbers but not for all cucurbit hosts. Drip irrigation should be used instead of overhead sprinklers if possible and plants should not be handled when the leaves are wet. Infected fruit and vines should be removed and destroyed, and not used for seeds.

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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 *Pseudomonas syringae* pv. *lachrymans:*

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'. There are records in California, but all predate modern identification techniques with DNA sequencing

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 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 possible that *P. syringae* pv. *lachrymans* is not established anywhere in California. No detections have been reported for 30 years, and cucurbit fields grown for export seed are inspected annually without detections.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Pseudomonas syringae* pv. *lachrymans* is B.

References:

CABI Crop Production Compendium 2020. *Pseudomonas syringae pv. lachrymans*. https://www.cabi.org/cpc/datasheet/44969 Accessed 6/18/2020

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French, A. M. 1989. California plant disease host index. CA Division of Plant Industry. 2nd Ed. 394 pg

Harighi, B., 2007. Angular leaf spot of cucumber caused by *Pseudomonas syringae* pv. *lachrymans* in Kurdistan. Plant disease, 91(6), pp.769-769.

Komoto Y; Kimura T, 1983. The process of seed transmission in angular leaf spot of cucumber. Bulletin of the Chugoku National Agricultural Experiment Station, E, No.21:1-20

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Pseudomonas syringae* pv. *lachrymans* Accessed 6/18/2020

Young, J.M., 2010. Taxonomy of *Pseudomonas syringae*. Journal of Plant Pathology, pp. S5-S14.

Young, J.M., Dye, D.W., Bradbury, J.F., Panagopoulos, C.G. and Robbs, C.F., 1978. A proposed nomenclature and classification for plant pathogenic bacteria. New Zealand Journal of Agricultural Research, 21(1), pp.153-177.

Responsible Party:

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***Comment Period: 7/21/2020 through 9/4/2020**

***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