

**California Pest Rating Proposal for**  
***Xanthomonas vesicatoria* (Doidge) Dowson 1939**  
**(Bacterial spot of tomato and pepper)**

**Current Pest Rating: C**

**Proposed Pest Rating: C**

Domain: Bacteria; Phylum: Proteobacteria,  
Class: Gammaproteobacteria; Order: Xanthomonadales,  
Family: Xanthomonadaceae

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**Comment Period: 10/05/2020 through 11/19/2020**

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**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 of 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 *Xanthomonas vesicatoria* is given herein and a permanent pest rating is proposed

**History & Status:**

**Background:** Bacterial spot is one of the most devastating diseases of pepper and tomato. The disease occurs worldwide where pepper and tomato are grown in warm, wet and humid areas. When it infects transplants soon after they reach the field, and weather conditions remain favorable for disease development, the epidemic can lead to total crop loss (Ritchie, 2000).

Ethel M. Doidge described a bacterium causing bacterial spot of tomato in South Africa as *Bacterium vesicatorium* in 1921. This was later reclassified as *Xanthomonas vesicatoria* and later as *X. campestris* pv. *vesicatoria* and was considered the cause of bacterial spot on both tomato and pepper. Following the discovery of two distinct genetic groups, Vauterin et al. (1995) proposed species status for these

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groups as *X. vesicatoria* and *X. axonopodis* (syn. *campestris*) pv. *vesicatoria*. In 2004, Jones et al. published a reclassification of xanthomonads associated with bacterial spot disease of tomato and pepper. With DNA-DNA hybridization studies, they described four distinct groups, and recommended elevating each to species status as follows: Group A: *X. euvesicatoria* (= *X. campestris* (*axonopodis*) pv. *vesicatoria*), Group B: *X. vesicatoria*, Group C: *X. perforans*, and Group D: *X. gardneri*. Isolates from all 4 groups can infect tomatoes; isolates from A, B, and D can infect peppers.

*Xanthomonas vesicatoria* has been extensively studied and used as a model organism for studying host-pathogen interactions and the role of avirulence genes at the molecular level. These types of studies have increased the understanding of pathogen host range and genetic resistance along with the molecular basis of the gene-for-gene model.

There is a second bacterial disease of tomato in California caused by *Pseudomonas syringae* pv. *tomato*. This disease is called bacterial speck, and symptoms can be very similar to bacterial spot, caused by *X. vesicatoria*.

**Hosts:** *Capsicum* spp. (peppers) (including *C. annuum*, bell pepper), *Solanum lycopersicum* (tomato).

**Symptoms:** On peppers, bacterial spots appear on leaves, stems, and fruit. Leaf spots begin as small, angular spots on the undersurface of the leaf. The spots are initially water-soaked, but later turn brown. Elongated raised cankers form on the stems. Fruit spots are circular, brown, and become raised with a cracked, roughened, and warty surface. (Koike et al., 2009). On tomatoes, bacterial spot can develop on seedlings and on mature plants. Seedlings may become severely defoliated. On older plants, infections appear as water-soaked areas, primarily on older leaves. Leaf spots can change from yellow or light green to black or dark brown. Older spots are black, slightly raised, and superficial. Larger leaf blotches can occur, especially on the leaf margins. Symptoms on young fruit are at first slightly sunken and surrounded by a water-soaked halo. The halo will disappear as the fruit spots enlarge, turn brown, and become scabby. Symptoms develop rapidly at temperatures of 22°C and higher. Night temperatures of 16°C or lower slow disease development, regardless of high daytime temperatures. (Davis, 2013).

**Transmission:** Some pathogen strains are virulent on either tomato or pepper, and some may be virulent on both. *Xanthomonas vesicatoria* is seedborne (within seed and on the seed surface) and seed transmitted, both at high levels. Moist weather and water splash are essential for dissemination of the bacteria. Transplant production nurseries are favorable for the bacterium because overhead sprinklers are commonly used. The wet and crowded plants are at high risk of mass infection. The bacteria can persist in crop debris, on volunteer tomatoes, and as epiphytes on weeds such as nightshade and groundcherry. Secondary spread within a transplant nursery or field occurs by splashing water from sprinkler irrigation or rain. Infection is favored by high relative humidity and free moisture on the plant (Ritchie, 2000).

**Damage Potential:** This disease can be destructive to tomato and pepper seedlings and can result in total crop loss in warm and humid areas (e.g. Florida) due to the development of large epidemics. Severe damage on enlarging fruit makes them unmarketable due to poor quality. Chemical controls are

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only marginally effective once the epidemic is underway. When the disease occurs in commercial pepper fields early in the season, some growers choose to destroy the entire crop by disking because the disease is so difficult to control once present in the field (Ritchie 2000). Using clean seed is very important. Volunteer plants can be the main source of initial inoculum even if clean seed is used and transplants are safeguarded from nursery sources of inoculum.

**Worldwide Distribution:** Africa: *Comoros, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Morocco, Mozambique, Niger, Nigeria, Réunion, Senegal, Seychelles, South Africa, Sudan, Tanzania, Togo, Tunisia, Zambia, Zimbabwe.* Asia: *Azerbaijan, China, India, Israel, Japan, Kazakhstan, Nepal, North Korea, Pakistan, Philippines, Saudi Arabia, South Korea, Taiwan, Thailand, Turkey.* Europe: *Austria, Belarus, Bulgaria, Czechia, France, Greece, Hungary, Italy, North Macedonia, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia, Spain.* North America: *Antigua and Barbuda, Bahamas, Barbados, Bermuda, Canada, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Honduras, Jamaica, Martinique, Mexico, Nicaragua, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, U.S. Virgin Islands, United States, (Arizona, California, Florida, Georgia, Hawaii, Indiana, Iowa, Michigan, New Mexico, North Carolina, Ohio, Oklahoma).* Oceania: *American Samoa, Australia, Federated States of Micronesia, Fiji, New Caledonia, New Zealand, Palau, Tonga.* South America: *Argentina, Brazil, Chile, Colombia, Paraguay, Suriname, Uruguay, Venezuela*

**Official Control:** *Xanthomonas vesicatoria* is on EPPO's A1 quarantine list for Azerbaijan and Georgia, and on the A2 List for Egypt and Turkey (EPPO, 2020). It is on USDA PCIT's harmful organism list for Iran (2020). CDFA Phytosanitary Field Inspection Manual for Seed lists *X. vesicatoria* as a pest of concern for both peppers and tomatoes.

**California Distribution:** Older records describe the distribution in California as along the northern and southern coast, and in the northern and southern Central Valley. More recent records are specific to Colusa, San Joaquin, Sutter, Monterey, and Stanislaus counties.

**California Interceptions:** None

The risk *Xanthomonas vesicatoria* would pose to California is evaluated below.

## Consequences of Introduction:

- 1) Climate/Host Interaction:** This pathogen needs warm and wet weather to cause disease capable of developing into epidemics. Most California tomato production is in dryer parts of the state including the Central Valley.

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.

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- **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 tomatoes and peppers.

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:** This bacterial pathogen can multiply very rapidly under ideal environmental conditions. It is dispersed by rain or sprinkler splash, and by handling of plants during transplanting, tying, or harvesting.

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 economic impact is directly related to the size of the disease epidemic. *Xanthomonas vesicatoria* is on the CDFA Phytosanitary field inspection list for peppers, and tomatoes as a pest of concern.

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

**Economic Impact:**

- 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:** This disease is not commonly seen in commercial fruiting fields because of the use of clean seed and conditions unfavorable to disease development. It can be a problem for home gardeners who lack access to clean seed sources and use sprinkler irrigation.

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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 *Xanthomonas vesicatoria*: 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 'medium'.** Detections have been made in several counties, on the coast and in the interior valleys. However, it is not a widespread problem in the main tomato and pepper production areas.

**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)**
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**Final Score:** *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 9*

**Uncertainty:**

None

**Conclusion and Rating Justification:**

Based on the evidence provided above the proposed rating for *Xanthomonas vesicatoria* is C.

**References:**

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### Responsible Party:

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**\*Comment Period: 10/05/2020 through 11/19/2020**

### \*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](mailto:permits[@]cdfa.ca.gov).

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### 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.
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- ❖ Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.
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**Proposed Pest Rating: C**

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