CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Xanthomonas cucurbitae (Bryan 1926) Vauterin et al. 1995

Pumpkin spot

Pest Rating: B

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

Comment Period: 12/12/2024 through 01/26/2025

Initiating Event:

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

History & Status:

Background:

Xanthomonas is a genus of phytopathogenic bacteria with many species that cause diseases such as citrus canker, vascular wilts, leaf and fruit spots, and blights of annual and perennial plants. Unlike other genera of phytopathogenic bacteria that typically occupy a diversity of ecological niches, almost all *Xanthomonas* species are plant pathogens and are found only in association with plants or plant materials. Some begin their plant host associations as epiphytes, using surface polysaccharides and forming biofilms, then transition to a pathogenic lifestyle under favorable conditions. Xanthomonas spp. produce xanthomonadins, pigments that protect them from natural light and can give them yellow colors in axenic culture.

Most *Xanthomonas* species are limited in their range and subspecific pathovar designations have been assigned to some to reflect that specificity (Agrios, 2005). In the past, bacterial taxonomists worked from what they thought were the most important phenotypic characteristics of their strains. The taxonomy of xanthomonads was based on a single feature, host specificity, and this was used to name species. This method, over time, resulted in an unreasonable number of nomenspecies. Dye et al. (1980) drastically reduced this and relied mainly on one species, *X. campestris*, and developed a

special-use classification system below species with pathovar names for phytopathological variants. In 1995, Vauterin et al. created a new taxonomic system based on DNA homology data that considered both the genomic relationships among strains and the needs of plant pathologists to have a rational nomenclature for practical daily use.

This disease was first found and described as a bacterial leaf spot on Hubbard squash in New York in 1926 as *Bacterium cucurbitae* (Bryan, 1930). Dye et al. (1980) classified it as *Xanthomonas campestris* pv. *cucurbitae*. Vauterin et al. (1995) described and separated *X. cucurbitae* sp. nov. from *X. campestris* pv. *cucurbitae* and designated a species-type strain. Diseases of cucurbits caused by *X. cucurbitae* can be of economic importance in tropical and temperate production areas, most often within the *Cucumis, Cucurbita*, and *Citrullus* genera.

California is a top producer of cucurbits including pumpkins, melons, squash, honeydew, cantaloupes, and cucumbers, both for fruit and export seed. The 2022/2023 acreage for the area harvested was 56,000 and the total value exceeded $500M (https://www.cdfa.ca.gov/Statistics/PDFs/2022-2023_california_agricultural_statistics_review.pdf).

Hosts: Cucurbita argyrosperma (cushaw squash), *C. maxima* (squash), *C. melo* (melon), *C. moschata* (butternut squash), *C. pepo* (pumpkin), *Cucumis sativus* (cucumber), *Citrullus lanatus* (watermelon), *Lagenaria siceraria* (calabash), *Sicyos angulatus* (bur cucumber) (CABI, 2024).

Symptoms: Initial symptoms develop on the leaves as small, marginal, transparent or chlorotic spots that expand towards the center of the leaves. Flatter, necrotic areas develop forming dead brown areas that eventually occupy the entire leaf surface. Necrotic lesions do not drop out as spots on cucurbits as do diseases caused by *Pseudomonas* spp. Symptoms can also develop as water-soaked areas that turn necrotic on stems, vines, tendrils, and floral parts. In highly favorable conditions, an amber-colored ooze escapes from the lesions. Vines can turn completely necrotic and die. In the case of attack on female flowers, there is no fruit formation (Babadoost and Ravanlou, 2012).

Symptoms on young fruits appear as water-soaked spots leading to a rotting of the fruit. On mature fruits, the symptoms develop as slightly sunken, circular spots, each with a beige center and dark brown halos. In severe cases, the fruits become deformed and covered with cracks which finally rot as secondary pathogens invade (Jarieal et al., 2015; Babadoost and Ravanlou, 2012)).

Transmission: Xanthomonas cucurbitae is a seedborne pathogen, carried on and in the seed (Babadoost and Ravanlou, 2012). The pathogen was still viable after being recovered from pumpkin plant debris two years after harvesting pumpkins in commercial fields (Thapa et al., 2020), although it is not considered to be truly soil-borne (Stall et al., 1993). It can be spread with rain and sprinkler irrigation and by people and equipment from contaminated fields.

Plant-pathogenic bacteria are also known to survive as epiphytes on nonhost plants that then serve as reservoirs of inoculum. This pathogen has been found associated with the following asymptomatic weeds: *Amaranthus spinosus* (spiny amaranth), *Bassia scoparia* (burning bush), *Chenopodium album* (lamb's-quarters), *Cichorium intybus* (chicory), *Cirsium arvense* (field thistle), *Datura stramonium*

(thorn-apple), *Daucus carota* (carrot), *Digitaria sanguinalis* (hair crabgrass), *Ipomoea purpurea* (common morning-glory), *Lactuca serriola* (prickly lettuce), *Malva neglecta* (common mallow), *Medicago lupulina* (black medic), *Polygonum aviculare* (knotweed), *Portulaca oleracea* (purslane), *Rumex acetosella* (sorrel), *Sonchus oleraceus* (common thistle), *Taraxacam officinale* (dandelion), *Tribulus terrestris* (cat's-head), *Trifolium repens* (white clover), and *Xanthium strumarium* (cocklebur) (Sulley et al., 2021).

Damage Potential: Before 2005, outbreaks were considered sporadic in the Midwestern United States, but it has been increasing. The disease was observed in more than 85 percent of the fields sampled across eight states, including Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska, Ohio, and Wisconsin, causing as much as 90 percent yield loss in severely affected fields. In the last three years, pumpkin spot outbreaks have had a significant impact on the pumpkin industry in Illinois (Ravanlou and Babadoost, 2015; Liu et al., 2016; Thapa and Babadoost, 2016).

Worldwide Distribution: Africa: *Egypt, Réunion, Seychelles*. Asia: *Brunei, China, India, Japan, Nepal*. Europe: *France, Italy*. North America: *Canada, Trinidad and Tobago, United States* (*Colorado, Connecticut, District of Columbia, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New York, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, Washington, Wisconsin*). Oceania: *Australia, New Zealand.* South America: *Argentina, Brazil, Uruguay* (CABI, 2024).

Official Control*: Xanthomonas cucurbitae* is on the EPPO's A1 list for Chile and is a regulated quarantine pest in Mexico (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Chile and Cuba (USDA PCIT 2024).

California Distribution: none

California Interceptions: none

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

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen thrives in warm, humid conditions. Rain and high humidity are uncommon in California where the summers are very hot and dry at the time that fruit is ripening, and when seed could potentially become infected.

   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 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 includes multiple types of cucurbits.

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:** Bacterial plant pathogens can increase exponentially under highly favorable conditions. This pathogen can spread with rain and sprinklers and can be moved with contaminated seed. It is also spread by equipment and people in the fields.

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:** Severe economic losses are reported to be caused by pumpkin spot epidemics but mainly in the warm, humid summer climates. Fruit infection has been reported at rates of 90% in some fields (Babadoost and Ravanlou, 2012).

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

Economic Impact: A, B, C.

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: **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:** A single detection in a seed field can disqualify the seed crop from export certification.

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 *Xanthomonas cucurbitae:* 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 '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.
-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* ***= 11***

Uncertainty:

Differentiation between *Xanthomonas* and *Pseudomonas*-incited leaf spots and specks and the ability to identify them to the species and subspecies levels requires an expert diagnostician. The presence of seed-borne bacterial pathogens has quarantine implications for export seed certification.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Xanthomonas cucurbitae*** **is B.**

References:

Agrios, G. N. 2005. Plant Pathology, 5th Edition. Elsevier Academic Press. 922 pg

Babadoost, M., and Ravanlou, A. 2012. Outbreak of bacterial spot (*Xanthomonas cucurbitae*) in pumpkin fields in Illinois. Plant Dis. 96:1222.

Bryan, M. K. 1930. Bacterial leaf spot of squash. J. Agric. Res. 40:385-391.

CABI Compendium. 2024. *Xanthomonas cucurbitae* https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.56928

Dye, D. W., Bradbury, J., Goto, M., Hayward, A. C., Lelliott, R. A. and Schroth, M. N., 1980. International standards for naming pathovars of phytopathogenic bacteria and a list of pathovar names and pathotype strains. Review of Plant Pathology, 59(4), pp.153-168.

EPPO Database. *Xanthomonas cucurbitae*. https://gd.eppo.int/taxon/XANTCU Accessed 11/19/2024

Jarial, K., Jarial, R.S. and Gupta, S.K., 2015. Bacterial spot (*Xanthomonas cucurbitae*) of cucurbits: a review. NBU Journal of Plant Sciences Vol. 9

Liu, Q., Ravanlou, A. and Babadoost, M., 2016. Occurrence of bacterial spots on pumpkin and squash fruit in the north-central region of the United States and bacteria associated with the spots. Plant disease, 100(12), pp.2377-2382.

Ravanlou, A. and Babadoost, M., 2015. Development of bacterial spot, incited by *Xanthomonas cucurbitae*, in pumpkin fields. HortScience, 50(5), pp.714-720.

Stall, R. E., Gottwald, T. R., Koizumi, M., and Schaad, N. C. 1993. Ecology of plant pathogenic xanthomonads. Pages 265-299 in: *Xanthomonas*. J. G. Swings and E. L. Civerolo, eds. Springer, Dordrecht, the Netherlands.

Sulley, S., Hind, S.R. and Babadoost, M., 2021. Survival of *Xanthomonas cucurbitae* in Different Crop Rotations, Plant Debris, and Weeds in Pumpkin Fields. Plant Health Progress, 22(4), pp.529-535.

Thapa, S. and Babadoost, M., 2016. Effectiveness of chemical compounds and biocontrol agents for management of bacterial spot of pumpkin caused by *Xanthomonas cucurbitae*. Plant Health Progress, 17(2), pp.106-113.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Xanthomonas cucurbitae*. Accessed 11/19/2024.

Vauterin, L., Hoste, B., Kersters, K. and Swings, J., 1995. Reclassification of *Xanthomonas*. International Journal of Systematic and Evolutionary Microbiology, 45(3), pp.472-489.

Responsible Party:

Heather J. Martin, 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: 12/12/2024 through 01/26/2025

*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: B
