CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Xanthomonas hortorum pv. *pelargonii* (Brown 1923) Vauterin et al. 1995

Bacterial blight of geranium

Current Pest Rating: C

Proposed Pest Rating: C

Domain: Bacteria Phylum: Proteobacteria

Class: Gammaproteobacteria Order: Xanthomonadales

Family: Xanthomonadaceae

Comment Period: 6/30/2020 through 8/14/2020

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 *Xanthomonas hortorum* pv. *pelargonii* is given herein and a permanent pest rating is proposed.

History & Status:

Background: Geraniums (*Pelargonium x hortorum*) are popular temperate and tropical garden plants grown and traded worldwide. They are almost exclusively propagated as named varieties and by vegetative cuttings. There are two serious vascular bacterial pathogens that affect geraniums, one is Southern wilt, caused by *Ralstonia solanacearum* race 3 biovar 2, the other is Bacterial blight caused by *Xanthomonas hortorum* pv. *pelargonii.* Diseases of vegetatively propagated plants that invade the vascular system are difficult to detect and the production of pathogen-free cuttings is vital. With strict control of Southern wilt as a select agent on the USDA's bioterrorism list, Bacterial blight is the most

serious problem limiting geranium production worldwide, causing significant annual economic losses (Nameth et al., 1999; Daughtrey and Benson, 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. in 1980 drastically reduced this into 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. Species they described and separated from *X. campestris* include *X. hortorum* sp. nov., including *X. hortorum* pv. *hederae* from ivy, *X. hortorum* pv. *vitians* from lettuce, and *X. hortorum* pv. *pelargonii* from geranium.

Hosts: Geranium sanguineum (bloody cranesbill), *Pelargonium x hortorum* (geranium), *P. peltatum* (ivy geranium), and *P. graveolens* (rose geranium) (CABI-CPC, 2020).

Symptoms: Symptoms of disease vary greatly among cultivars of geranium and plants that are systemically infected can die. On infected leaves, the disease can appear initially as small translucent or watery pustules, similar to the abiotic edema that is common on geraniums. Additionally, small yellow spots can appear that gradually increase in size becoming irregular in shape, and then brown and necrotic. The margins of the dead spots are well defined and surrounded by yellow halos, or a large section of yellowed leaf may contain several necrotic spots. V-shaped yellow areas can develop when the bacteria enter a hydathode and spread in the leaf veins. When infection of the stem vascular tissue occurs, leaves on individual branches wilt without other symptoms. For *P. peltatum*, entire leaves will yellow, die, and drop but have no other symptoms (Nameth et al., 1999).

The vascular tissue inside stems with wilted leaves usually show brown discoloration. Infected stems can become brown or black, but usually remain stiff even as they desiccate. When discolored vascular tissue, leaf spots, or the narrow end of V-shaped yellowed leaf lesions are excised and placed in water on a microscope slide, cloudy masses of bacteria can ooze from the tissues (Nameth et al., 1999).

Transmission: Bacteria initially enter plants through stomates, pores, or small wounds on leaf surfaces. Vegetatively propagated cultivars of florists' geranium (*P. × hortorum*) and ivy geranium (*P. peltatum*) are most commonly affected, because the pathogen inhabits the vascular tissue of infected mother plants and their cuttings. *Xanthomonas hortorum* pv. *pelargonii* is not known to be internally seedborne, although seedlings are susceptible to infection. The pathogen survives in infected stock plants and can survive in contaminated soil for up to 3 months. Infected stock plants may be symptomless, especially under the cooler winter temperatures (60-70 °F) (Nameth et al., 1999).

Cutting knives can be contaminated and spread the bacteria to clean plants when vegetative cuttings are taken from infected mother plants (Munnecke, 1964). Even with strict sanitation efforts, bacteria can still enter geranium production facilities through surface contaminated seeds, infected propagative

materials, aerosols, wind, and people (Daughtrey et al., 1995). Once introduced, bacteria become established and spread rapidly through contact or through irrigation (Daughtrey and Benson, 2005).

Damage Potential: Annual losses due to bacterial blight were estimated to be 10 to 15% 75 years ago and losses continue today (Munnecke, 1954; Mirik et al., 2018; Balaž et al., 2016). In individual greenhouse operations, entire geranium crops have been lost to this disease, and specialty propagators have been put out of business or severely damaged when they unknowingly sold asymptomatic, but infected cuttings and distributed them throughout the bedding plant industry (Daughtry and Benson, 2005). Plants with spotted leaves, stunted growth, or wilted stems are generally not acceptable to consumers. To produce disease-free plant materials, modern facilities rely on strict sanitation and disease indexing of mother plants to prevent bacterial disease outbreaks.

Worldwide Distribution: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Egypt, France, Germany, Greece, Hungary, India, Iran, Italy, Japan, Morocco, Netherlands, Portugal, Romania, Russia, Serbia, South Africa, Sweden, Switzerland, Turkey, United Kingdom, United States (California, Florida, Minnesota, Texas, Washington) (CABI-CPC, 2020; Balaž et al., 2016)

Official Control: Quarantine pest in Mexico, A2 list for Jordan (EPPO, 2020) USDA Harmful organism list for Colombia, Guatemala, Israel, Jordan, Mexico, and Taiwan (USDA PCIT, 2020

California Distribution: Widespread (French, 1989; Koike and Wilen, 2009).

California Interceptions: None

The risk *Xanthomonas hortorum* pv. *pelargonii* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Geraniums are widely grown in California as annuals where winter temperatures are low and perennials in areas that are generally frost free. The pathogen lives internally in the vascular system and is not limited by climate.

   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 of *X. hortorum* pv. *pelargonii* is limited to a few species of geraniums.

   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 pathogen is mostly limited to the vascular system of its hosts without significant survival in soil or water. It is mostly moved with infected cuttings can also spread inside a greenhouse with water splash, aerosols, and handling of infected plants

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:** When infected mother plants are used for cuttings, this disease can cause complete crop loss. With strict sanitation and indexing of propagative material, losses can be reduced to near zero.

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

Economic Impact: A, 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: **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:** With a limited host range, environmental impacts have not been observed. Home gardens and ornamental plantings can be affected

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 hortorum* pv. *pelargonii:* *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 'high'.

Score: -3
-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* **= 7**

Uncertainty: None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Xanthomonas hortorum* pv. *pelargonii* is C.

References:

Balaž, J., Ivanović, Ž., Davidović, A., Iličić, R., Janse, J. and Popović, T., 2016. Characterization of *Xanthomonas hortorum* pv. *pelargonii* Isolated from Geranium in Serbia. Plant disease, 100(1), pp.164-170.

CABI Crop Production Compendium 2020. Xanthomonas hortorum pv. pelargonii. 2020 https://www.cabi.org/cpc/datasheet/56960. Accessed 5/21/2020

Daughtrey, M. L, Wick, R. L., and Peterson, J. L. 1995. Compendium of Flowering Potted Plant Diseases Volume 24 APS Press, St. Paul, MN

Daughtrey, M. L. and Benson, D. M., 2005. Principles of plant health management for ornamental plants. Annu. Rev. Phytopathol., 43, pp.141-169.

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 Global Database. 2020. https://gd.eppo.int/taxon/XANTPE accessed 5/21/2020

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

Koike, S. T., and Wilen, C. A. 2009. UC IPM Pest Management Guidelines: Floriculture and Ornamental Nurseries UC ANR Publication 3392. http://ipm.ucanr.edu/PMG/r280111511.html

Mirik, M., Aysan, Y., and Baysal-Gurel, F. 2018. Bacterial spot and blight diseases of ornamental plants caused by different *Xanthomonas* species in Turkey. Plant Protect. Sci., 54: 240–247

Munnecke, D. E., 1954. Bacterial stem rot and leaf spot of Pelargonium. Phytopathology, 44(11), pp.627-632.

Nameth, S. T., Daughtrey, M. L., Moorman, G. W. and Sulzinski, M. A., 1999. Bacterial blight of geranium: a history of diagnostic challenges. Plant disease, 83(3), pp.204-212.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Xanthomonas hortorum pv. pelargonii*. Accessed 2/26/2020

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:

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***Comment Period: 6/30/2020 through 8/14/2020**

***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: C
