

California Pest Rating Proposal for
***Pectobacterium atrosepticum* (van Hall) Gardan et al. 2003**

Blackleg of potato

Current Pest Rating: none

Proposed Pest Rating: C

Domain: Bacteria; Phylum: Proteobacteria
Class: Gammaproteobacteria; Order: Enterobacteriales
Family: Pectobacteriaceae

Comment Period: 3/23/2020 through 5/7/2020

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 *Pectobacterium atrosepticum* is given herein and a permanent pest rating is proposed.

History & Status:

Background:

Blackleg is a serious, worldwide disease of potatoes caused by a pectolytic bacterium, *Pectobacterium atrosepticum*. The term "blackleg" describes the typical blackening and decay of the lower stem portion or the "leg" of the plant. *Pectobacterium atrosepticum* (synonym: *Erwinia carotovora* subsp. *astroseptica*) is a gram-negative, nonsporulating, facultatively anaerobic bacterium that can live in the soil, water, and plant debris. *Pectobacterium carotovorum* and *Dickeya dadantii* are two related pectolytic bacterial pathogens that can cause symptoms similar to blackleg of potato. However, these two species are typically associated with classic soft rot disease symptoms and have a wider host

range. They can be separated from each other with DNA sequence-based diagnostic techniques (Gardan et al., 2003).

There have been changes to the ways that *P. atrosepticum* has been described and classified over time. As a result, many past reports of *P. atrosepticum* could instead be diseases caused by other soft rot *Pectobacterium* or *Erwinia* species. *Bacillus atrosepticus* was the earliest name for this pathogen when it was first described as the cause of potato blackleg (van Hall, 1902). In 1984, Lelliott and Dickey changed the name to *Erwinia carotovora* and added the subspecies *atroseptica* based on biochemical characteristics. Hauben et al. in 1998 divided the genus *Erwinia* into three phylogenetic groups and moved five subspecies of *Erwinia carotovora* including subspecies *atroseptica*, to the genus *Pectobacterium*. Using a genotypic approach, in 2003 Gardan et al. elevated *P. carotovorum* subsp. *atrosepticum* to *P. atrosepticum*.

Hosts: *Solanum tuberosum* (potato) is the major host for this pathogen and the most important and widespread disease that *P. atrosepticum* causes is blackleg of potato. In the past, *P. atrosepticum* was thought to be a cool temperature variant of *E. carotovora* subsp. *carotovora* and was implicated in causing soft rots on a much longer list of vegetables and weeds (Agrios, 2005; CABI-CPC, 2020). Many incorrect host reports may have been based on misidentifications of *P. atrosepticum* as *Erwinia* or *Dickeya* species, or other *Pectobacterium* species.

Allium cepa (onion), *Asparagus officinalis* (asparagus), *Brassica oleracea* var. *botrytis* (cauliflower), *Brassica oleracea* var. *capitata* (cabbage), *Brassica oleracea* var. *gemmifera* (Brussels sprouts), *Brassica oleracea* var. *viridis* (collards), *Brassica rapa* subsp. *chinensis* (Chinese cabbage), *Brassica rapa* subsp. *rapa* (turnip), *Carica papaya* (pawpaw), *Cichorium intybus* (chicory), *Coffea arabica* (coffee), *Consolida ambigua* (rocket larkspur), *Cucumis sativus* (cucumber), *Cyphomandra betacea* (tree tomato), *Datura stramonium* (jimsonweed), *Daucus carota* (carrot), *Euphorbia pulcherrima* (poinsettia), *Glycine max* (soybean), *Helianthus annuus* (sunflower), *Helianthus tuberosus* (Jerusalem artichoke), *Iris* (irises), *Lupinus* (lupins), *Musa* (banana), *Nicandra physalodes* (apple of Peru), *Nicotiana glauca* (tree tobacco), *Nicotiana rustica* (wild tobacco), *Nicotiana tabacum* (tobacco), *Phaseolus vulgaris* (common bean), *Saccharum officinarum* (sugarcane), *Saintpaulia* (african violet), *Solanum lycopersicum* (tomato), *Symphytum officinale* (blackwort), *Vicia faba* (faba bean), *Zantedeschia aethiopica* (calla lily), and *Zea mays* (maize) (Popović et al., 2017; CABI-CPC, 2020).

Symptoms: Blackleg disease of potato can develop early in the growing season soon after the plants emerge and is characterized by stunted, yellowish foliage that has a stiff, upright form. When the foliage becomes chlorotic, the leaflets tend to roll upward at the margins. The black leg symptoms start below ground and move up the stems. Infected plants wilt. The stems of infected plants may have a dark pith or the lower stems may have an extensive, external and internal inky black decay. Young plants fail to develop further and usually die. If the disease infects older plants, a black discoloration of previously healthy stems leads to a rapid yellowing of leaves with premature senescence or wilting. There is an associated decline in tuber yield.

Tubers in the field generally become decayed at the stolon attachment site and the tissues become blackened and soft. As the disease progresses, the entire tuber may decay, or the rot may be localized to the inner perimedullary (or parenchymal) tissue inside the tuber's vascular ring.

Tubers in storage can become extensively soft rotted and decayed if bacteria are on their skin at the time of harvest. If humidity is kept low, decay lesions around tuber lenticels or mechanically damaged areas grow slowly, resulting in a condition known as "hard rot." Potatoes with hard rot have slightly sunken, brownish-black, dry, necrotic lesions surrounding individual lenticels or damaged areas. Once the tubers are damaged by *P. atrosepticum*, growth of secondary bacteria often contributes to the decay process and leads to complete maceration of tuber tissue and seepage of putrid, dark-colored liquids. (De Boer and Rubio, 2004; Nunez et al., 2019; CABI-CPC, 2020).

Bacterial stalk and head rot on sunflower caused by *P. atrosepticum* was reported in Turkey in 2008 by Baştaş et al. and symptoms were described as dark and water-soaked necrotic areas on stems and heads with bacterial droplets and ooze. Popović et al., 2017, found *P. atrosepticum* causing water-soaked necrotic lesions on leaves and stems of calla lilies in Serbia, resulting in collapse of whole plants.

Transmission: Potato tubers can be infected directly from inoculum in the soil or infested irrigation water, or plants can be systemically infected by planting contaminated or infected seed tubers. *Pectobacterium atrosepticum* can move via the vascular bundles directly into the growing plant. If the seed tuber is unable to grow due to decay from *P. atrosepticum*, bacteria may still seep from the decaying seed piece into the soil and contaminate the root zone and infect proximal healthy seed tubers (De Boer and Rubio, 2004).

Damage Potential: In the past, this disease could be severe for potatoes and cause crop failures. Moist, cool conditions favor the pathogen and worsen disease both as seed tuber decay increases and as the spread of the pathogen into the stem are highly dependent on environmental conditions. Potato plants should be in well-drained fields and planted far enough apart to allow adequate ventilation. Potato crops should be rotated with cereals or other nonsusceptible crops. Few varieties have any resistance to blackleg and there is no immunity (Agrios, 2005). Strict sanitation, changes in cultural practices especially starting with clean seed potatoes has reduced field losses dramatically (De Boer and Rubio, 2007). For sunflowers in Turkey, disease incidence was estimated at 30% (Baştaş et al., 2009). Popović et al. (2017) reported a disease incidence of 20 to 30% for calla lilies.

Worldwide Distribution: Worldwide in potato producing areas (CABI-CPC; 2020)

Official Control: *Pectobacterium atrosepticum* is on the EPPO's A1 list in Argentina and A2 list in Jordan and is a Quarantine pest in Mexico and a regulated non-quarantine pest in Egypt and Bahrain (EPPO, 2020). It is on the USDA Harmful organism list for Jordan, Mexico, and Panama (USDA-PCIT, 2020).

California Distribution: There are no official records in the CDFA PDR database. However, University of California plant pathologists report that the pathogen is widely distributed on potatoes in California (Nunez et al., 2019; B. Aegerter, pers. comm.)

California Interceptions: None

The risk *Pectobacterium atrosepticum* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This is a soil and water-borne pathogen that can survive in crop debris and infected planting stock. The disease is most serious in cool, wet growing 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:** The host range of this pathogen is large with potatoes as the most important host.

Evaluate the host range of the pest.

Score: 3

- 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:** *Pectobacterium atrosepticum* can contaminate soil and water, and move with infected seed tubers or other vegetative planting material. It has not been associated with infection of true seed, but seed could be externally contaminated.

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:** This was once one of the most destructive potato diseases. Ongoing control is dependent on strict sanitary practices including clean seed programs.

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

Economic Impact: A, D, G

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 has already spread worldwide in potato growing areas. There are no reports of spread outside of agronomic crops.

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 *Pectobacterium atrosepticum*:

Add up the total score and include it here. **13**

-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'. Reports from the University of California Plant Pathologists are that this disease is widespread in potatoes statewide (Nunez et al., 2019).

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 = 10

Uncertainty:

Because of possible identification/nomenclature errors or changes from the past, it is not clear what the host range is for *P. atrosepticum*. It is likely restricted mostly to potatoes and to cool climates. Reducing the host range and adjusting the climate requirements would lower the score for this pest rating.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Pectobacterium atrosepticum* is C.**

References:

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Responsible Party:

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***Comment Period: 3/23/2020 through 5/7/2020**

*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).

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
