CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pseudomonas mediterranea

Catara, Sutra, Morineau, Achouak, Christen, & Gardan 2002

Current Pest Rating: Q

Proposed Pest Rating: B

Domain: Bacteria, Phylum: Proteobacteria

Class: Gammaproteobacteria, Order: Pseudomonadales

Family: Pseudomonadaceae

Comment Period: 8/18/2020 through 10/2/2020

Initiating Event:

On April 16, 2020, a sample of cannabis (*Cannabis sativa*) plants grown in aquaculture in Oakland, Alameda County was submitted to CDFA's Plant Pest Diagnostics Center for diagnosis. They were described as having unhealthy looking roots with a discolored vascular system. A single isolate of *Pseudomonas mediterranea* from the rotting *C. sativa* roots was detected in culture by CDFA plant pathologist Sebastian Albu. He made a phenotypic observation of non-fluorescing pseudomonads, a somewhat unusual trait that is also observed with isolates of *Pseudomonas corrugata*, another closely related pith necrosis-causing species. The identity of the *P. mediterranea* strain isolate from *C. sativa* was confirmed by PCR, DNA sequencing, and phylogenetic analysis of a dataset that included all published *Pseudomonas* spp. and pathovar type strains. *Pythium myriotylum* (a known oomycete root pathogen of *Cannabis* spp.) was also identified by CDFA plant pathologist Albre Brown by culture morphology and DNA sequencing. This was the first detection of *P. mediterranea* in California and it was given a temporary Q rating. A sample was sent to the USDA's National Identifier Mark Nakhla in Beltsville, Maryland. who confirmed the identification by cPCR and sequence analysis on July 14, 2020. The risk to California from *P. mediterranea* is described herein and a permanent rating is proposed.

History & Status:

Background: *Pseudomonas mediterranea* was first described by Catata et al. in 2002 when they separated it from a closely related species, *P. corrugata*, based on a comparison of 16S rRNA sequences. *Pseudomonas corrugata* causes pith necrosis on tomatoes, peppers, geranium, and chrysanthemum. It has been known to occur in California since 1976 (Lai et al., 1983) and has been reported from tomato, lettuce, pepper, orchid, and geranium. *Pseudomonas mediterranea* is a Gram-negative, non-spore-forming rod. This species has the same general characteristics as *P. corrugata* although it can be distinguished based on biochemical reactions and sequence analysis. The colonies of *P. mediterranea* on nutrient agar supplemented with 1%glucose are wrinkled or smooth. Yellow to brown pigments are frequently produced. The bacteria are motile by means of multiple polar flagella. It is strictly aerobic and does not fluorescence on King's B. *Pseudomonas corrugata*, *P. mediterranea*, *P. fluorescens*, and *P. viridiflava* can all be pathogenic and can co-occur in the pith of tomato and pepper (Trantas et al., 2015; Xu et al., 2013; Alippi and Lopez, 2010; Basim et al., 2005).

Hosts: Tomato (*Solanum lycopersicum*), pepper (*Capsicum annuum*), eggplant (*Solanum melongena),* tobacco (*Nicotiana tabacum*) (Catara et al., 2002).

Symptoms: Early symptoms of *P. mediterranea*-infected tomato plants are usually observed when the fruits of the first inflorescence are fully developed, but still green. Initially there is only a slight wilting and chlorosis on the new growth. Later, plants can exhibit transient lateral wilting or partial collapse. Soft, brown areas appear, which can spread until they cover large portions of the stems. Additional symptoms include the atypical formation of secondary roots, and the development of a with watery, laddered appearance and an intense brown to black discoloration of the pith. Rarely, there can be signs of yellow-brown bacterial exudate from the leaf scars (Trantas et al., 2015). Bacterial streaming can be observed microscopically from necrotic stem tissue (Xu et al., 2013).

Field-grown pepper plants exhibit chlorosis, wilting of leaves, and extensive necrosis of the pith, but no secondary roots have been reported. Brown spots are observed at the bases of the stems followed by bacterial exudate. Spots extend upwards, while the leaves gradually turn yellow, beginning from those at the top of the plant. Diseased plants have longitudinal dark brown lesions on the stems. The pith is initially brown and watery and eventually decays. In the region of decay, the vascular tissues show a brown discoloration, and eventually the infected plants die. The spread of the infection is slower in older plants (Trantas et al., 2015).

Transmission: The bacteria overwinter in plant debris in the soil, in dried diseased leaves, and on seed. Bacteria are carried to the leaves by rain splashing, by wind, or they may be accidentally spread during handling of the plants. This is especially a problem for greenhouse grown tomatoes and peppers that are handled frequently during training, staking, tying, pollinating, and harvesting. High humidity or a film of moisture must be present for infections to occur and for the development of epidemics. Bacteria enter the leaf through stomata, hydathodes, and wounds (Agrios, 2005). *Pseudomonas mediterranea* is soilborne and can be seedborne in tomatoes (Searcy et al., 2015).

Damage Potential: Bacterial pith necrosis is considered an important problem in tomatoes and peppers worldwide (Catara et al., 2002; Trantas et al., 2015, Lai et al., 1983). Usually it is referred to as a mild and opportunistic pathogen with 1-10% of plants affected, although individual plantings or greenhouses may suffer higher losses (Searcy et al., 2015; Xu et al., 2013). Co-infection with multiple *Pseudomonas* spp., all proven to cause similar symptoms on tomato, complicates the ability to estimate damage potential for each species individually.

Worldwide Distribution: Argentina, Brazil, France, Italy, Greece, Russia, Portugal, Spain, Saudi Arabia, Taiwan, Turkey, United States (California, Georgia, Ohio) (Alippi and López, 2010; Catara et al., 2002; Trantas et al., 2015; Pekhtereva et al., 2007; Tsai et al., 2018; Basim et al., 2005; Searcy et al., 2016; Xu et al., 2013; Moura et al., 2005; Sahin et al., 2005; Quezado-Duval et al., 2007; Molan et al., 2010).

Official Control: *Pseudomonas mediterranea* is a Q rated pathogen in California.

California Distribution: There has been one detection in Alameda County on *Cannabis sativa.*

California Interceptions: none

The risk *Pseudomonas mediterranea* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen has been recorded in both field-grown and greenhouse grown tomatoes and peppers and aqua-cultured cannabis. It is systemic in its hosts. Therefore, climate is not going to be an important factor.

   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 is moderate with some members of Solanaceae plus cannabis.

   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 pathogens multiply exponentially under favorable conditions. However, they require moisture on the leaf or stem surface to infect, which limits their potential in dry climates.

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:** Modest losses are reported in tomatoes and peppers. The effect on cannabis is unknown but may be higher in an aquaculture system.

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

Economic Impact: 2

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:** No impacts have been reported as to date it has only affected agronomic crops.

Environmental Impact:

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: 1

- **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 mediterranea:* 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 'Low'. One detection has been made from cannabis from Alameda County.

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:

The closely related bacterium, *P. corrugata*, which shares a similar phenotype with *P. mediterranea*, is known to occur in California. Several detections of *P. corrugata* were made by a former CDFA bacteriologist during 1997-1999 from multiple hosts, including lettuce, tomato, pepper, and orchid. This was prior to the description of *P. mediterranea* as a distinct species from *P. corrugata* in 2002. None these isolates, nor their sequence data, are available today. Therefore, the distribution of *P. mediterranea* may extend beyond what is currently known. It is possible that the detection of *P. mediterranea* in Alameda is incidental and the strain is not a pathogen of *Cannabis* spp. Pathogenicity tests are being planned to determine its virulence on cannabis and other hosts.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Pseudomonas mediterranea* is B.

References:

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Responsible Party:

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***Comment Period: 8/18/2020 through 10/2/2020**

***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