cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pseudomonas syringae pv. *pisi* (Sackett 1916) Young et al. 1978

Bacterial blight of pea

Current Pest Rating: C

Proposed Pest Rating: C

Comment Period: 11/10/2020 through 12/25/2020

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 *Pseudomonas syringae* pv. *pisi* (Psp) is given herein and a permanent pest rating is proposed.

History & Status:

Background: Bacterial blight of pea caused by *Pseudomonas syringae* pv. *pisi* (Psp) was first identified in 1915 in Colorado, and it has subsequently been found in all countries with pea production. Psp has been characterized as the world's most important bacterial pea disease (Lawyer and Chun, 2001). It occurs sporadically and it can be confused with disease caused by *P. syringae* pv. *syringae* (Pss), which has very similar symptomatology. This makes it very difficult to distinguish between them by visual inspection. Moreover, because the biochemical profiles of these pathovars are very similar, identification based exclusively on biochemical characteristics is has also been uncertain, necessitating molecular profiles for confirmation. Psp and Pss can also co-occur in the same plants or field, but Psp seems to cause greater yield losses (Lawyer and Chun, 2001). The total yield loss caused by these two pathovars is one of the limiting factors in pea production worldwide (Hollaway et al., 2007).

Different pathogenic races of Psp have been described based on their differential response following inoculation on pea genotypes (Bevan et al., 1995). The frequency of each race varies between regions,

but race 2 seems to be the most frequent race worldwide. Both pathovars of Psp and Pss, are primarily transmitted by infected seeds, although Pss has a wider host range with a possible resident phase in crop or weed species (Lawyer and Chun, 2001).

Hosts: Cynodon dactylon (Bermuda grass), *Digitaria sanguinalis* (large crabgrass), *Galium aparine* (cleavers), *Lablab purpureus* (hyacinth bean), *Lathyrus* (vetchling), *Lathyrus latifolius* (broad-leaved everlasting pea), *Lathyrus odoratus* (sweet pea), *Lepidium campestre* (field cress), *Pisum sativum* (pea), *Reseda lutea* (cutleaf mignonette), *Vicia* (vetch), and *Vicia benghalensis* (purple vetch) (CABI-CPC, 2020).

Symptoms: Symptoms of Psp can occur on all aerial plant parts of peas, including leaflets, petioles, stems, stipules, tendrils, flower buds, and pods. In wet weather, lesions start on leaflets and pods as dark-green water-soaked spots. Initially they are small and round, oval, or irregular. These spots can enlarge and coalesce, but on leaves they are sharply defined by the veins. Cream-colored bacterial ooze can occur on the surface of the lesions; this dries with a glossy appearance. The leaflets later become yellowish, with brown, papery spots.

During dry weather or following frosts, symptoms usually appear on the stem near the soil line as water-soaked lesions, and later become olive-green to purple-brown spots. The infection can extend upwards to the stipules and leaflets. Veins will turn brown or black and adjacent tissues can become diseased in a fan-like pattern. The interveinal tissues may appear water soaked, and then turn yellowish to brown, before drying out and becoming papery.

If the infection spreads systemically, the plants may wilt and die. If infection occurs on sepals and spreads to the flowers, buds may be killed before pods are formed. After infection the bacteria spread through the intercellular spaces and enter the parenchyma cells of the cortex and pith. Cavities are formed as the vascular tissues are broken down. From here the bacteria may spread to stipules, leaflets, and the inner sides of pods and into the seed. However, under warm and dry conditions, the infection can stop expanding, and the upper parts of the plants can remain green and can produce healthy flowers and pods. Healthy axillary growth can develop from the base of diseased plants. Pods become twisted and dry, and have sunken, greenish-brown lesions. When pods are infected, the seeds may be covered with bacterial slime. Infected seeds appear water-soaked or can shrivel, with a brownish-yellow discoloration (CABI-CPC, 2020; Hollaway et al., 2007; Lawyer and Chun, 2001).

Transmission: The most important means of spread from season to season and over long distances is with infected seed. Psp can multiply asymptomatically on seedlings grown from contaminated seed and high levels of disease can be observed in the field in as few as 14 days under ideal climatic conditions (Grondeau et al., 1996). Seed transmission to germinating seedlings is significantly reduced by higher temperatures at low soil water contents as cold, wet conditions are ideal for spread (Holloway et al., 1996).

Psp can survive for several months on diseased plant debris and volunteer plants that remain in the field. Epiphytic survival of Psp on weeds for as long as eight months after harvest and on buried crop debris has been observed by Grondeau et al. (1996). Since pea debris is a source of inoculum, crop

rotations which include two seasons without any peas should be used to reduce transmission (Hollaway and Bretag, 1997). Seeds may also become infected at harvest by contact with diseased material.

Damage Potential: California produces edible pod peas, field peas, and peas for export seed. All three can be damaged by Psp. For export seeds, fields need to be found free-from Psp by inspection, as Psp can reduce the seed yield and quality. Field pea crops in Australia were surveyed for the presence of Psp and the results showed the incidence of the pathogen was in excess of 30%. Under conditions suitable for development of the disease, severe epidemics could result (Holloway and Bretag, 1995). In Turkey, field inspections revealed disease incidence as high as 45% (Benlioglu et al., 2010).

Severe infections (reaching 100%) and substantial crop losses have been reported from winter-sown peas in southern France, New Zealand, and South Africa (Taylor, 1972). Cold and wet weather conditions favor epidemics as these bacteria can penetrate the host plant through lesions caused by frost injury. Psp can act as an ice nucleator under conditions just above freezing, increasing frost damage effects and lesions (Hirano and Upper, 2000). For the development of serious blight, wounds (e.g. those formed by hail, frost, or wind-blown sand) appear to be a prerequisite. Dry weather and high temperatures prevent disease spread (CABI-CPC, 2020).

Worldwide Distribution: Africa: *Kenya, Malawi, South Africa, Tanzania, Zimbabwe*. Asia: *Armenia, Georgia, India, Indonesia, Japan, Kazakhstan, Kyrgyzstan, Lebanon, Nepal, Pakistan, Syria, Turkey*. Europe: *Bulgaria, Croatia, Czechia, Denmark, France, Greece, Hungary, Italy, Lithuania, Moldova, Montenegro, Netherlands, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Switzerland, Ukraine, United Kingdom*. North America: *Bermuda, Canada, Costa Rica, Mexico*, *United States* (California, Colorado, Kansas, Washington, Wisconsin). Oceania: *Australia, New Caledonia, New Zealand*. South America: *Argentina, Brazil, Colombia, Ecuador, Uruguay* (CABI-CPC, 2020).

Official Control: USDA PCIT's harmful organism list for Algeria, Bangladesh, Chile, China, Ecuador, Egypt, French Polynesia, Honduras, Israel, Jordan, Republic of Korea, Madagascar, Namibia, New Caledonia, Panama, Paraguay, Peru, South Africa, Taiwan, Tunisia, and Turkey. EPPO's A1 list for Chile, Egypt, Paraguay, and Turkey; A2 list for East Africa and Jordan, and a quarantine pest for Israel and Tunisia. Psp is pest of concern for peas grown for export seed in California and is included in the phytosanitary field inspection program in this state (CDFA, 2020).

California Distribution: Psp has been detected only rarely in California. In Santa Barbara County it was found on cilantro, in Santa Cruz County it was found on magnolia, and in Sutter County it was found on peas.

California Interceptions: None

The risk *Pseudomonas syringae* pv. *pisi* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Epidemics are generally worse in cool, wet weather, but can be sporadic and unpredictable. Frost damage to plants is one factor in increasing severity of epidemics.

   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 includes plants of multiple genera from different families.

   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:** Psp are bacteria that, under ideal conditions, can multiply at an exponential rate. They can be spread by wind and rain, or by infested seed.

   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:** In countries such as Australia and Turkey that have climates similar to California, Psp is common in field peas. However, an epidemic level of disease occurs only when there is hail, frost, or damaging rainstorms, all of which are rare during the growing season.

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

   Economic Impact: A

   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: **1**

   - 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:** Psp has the potential to survive outside of a crop field on volunteer peas and weeds, either as a pathogen or possibly as an epiphyte.

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

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 syringae* pv. *pisi:* Low

Add up the total score and include it here. **8**
-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'. There have been very occasional detections in California on the central coast and in the north. Since it is a pest of concern in our Phytosanitary program for export seed, any symptomatic plants would be submitted to our Plant pest diagnostics center.

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)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* **= 6**

Uncertainty: None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Pseudomonas syringae* pv. *pisi* is C.

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USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Pseudomonas syringae* pv. *pisi*. Accessed 9/28/2020

Responsible Party:

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***Comment Period: 11/10/2020 through 12/25/2020**

***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