cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pseudomonas savastanoi pv. *glycinea* (Coerper 1919) Gardan et al. 1992

Bacterial blight of soybean

Current Pest Rating: none

Proposed Pest Rating: C

Comment Period: 11/24/2020 through 01/08/2021

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 savastanoi* pv. *glycinea* (Psg) is given herein and a permanent pest rating is proposed.

History & Status:

Background: Bacterial blight, caused by *Pseudomonas savastanoi* pv. *glycinea* (Psg), is a common bacterial disease of soybean and occurs in most soybean growing areas. With a dry summer climate and geographic isolation from major soybean production areas of the United States, California enjoys "freedom-from" status for many foliar and pod pathogens and therefore has a significant seed export industry. For seeds to qualify for federal phytosanitary certification for export, they must be free of several important seed-borne diseases including Psg.

This pathogen was previously classified as *P. syringae* pv. *glycines* by Young et al. (1978). At that time, they created a single species that had a large number of pathovars below the species level. Most of these pathovars had a high degree of host specificity and they were named after the host from which they were first isolated, or the major host on which they caused disease. In 1992, Gardan et al. used DNA hybridization data to show that there was a close relationship between *P. syringae* subsp. *savastanoi* (which causes olive knot) and *P. syringae* pv. *glycinea*. This elevated the subspecies to a

new species, *savastanoi*, with a pathovar *savastanoi* for strains infecting members of the genera Oleaceae. The pathovars from soybeans (*glycinea*), beans (*phaseolicola*), and tobacco (*tabaci*) were moved from *P. syringae* to *P. savastanoi*. In 1999, Gardan et al. used DNA-DNA hybridization and ribotyping to define nine discrete genomospecies within the *P. syringae* complex. Psg was placed in genomospecies 2, along with the nomenspecies *P. savastanoi*, confirming this is the best placement for this pathovar.

One way that plants defend themselves from pathogens is through the triggering of a hypersensitive response (HR). The HR occurs only when the pathogen fails to infect the host. It can occur when virulent strains of plant pathogenic bacteria are injected into nonhost plants, or into resistant varieties, or when nonvirulent strains are injected into susceptible varieties. It happens because the plant has a resistance gene which recognizes, and is triggered by, an elicitor molecule released by the pathogen. The elicitor is the product of a pathogen gene, which makes a pathogen avirulent, and is called an avirulence gene. The first avirulence gene product to be identified was a protein from Psg by Staskawicz et al. (1984). It was shown to be an enzyme involved in the synthesis of syringolides, which elicit the HR in soybean varieties that carry the resistance gene D complementary to avirulence genes of the bacterium.

As is common for many types of phytopathogenic bacteria, Psg has been subdivided further into races. These races are defined based on their reactions to differential soybean cultivars. The complete genome of Psg was sequenced and published by Qi et al. (2011), and these data have been used to better understand host specificity and virulence mechanisms. Breeding for resistance is an important disease management practice for soybeans.

Hosts: The natural host of *P. savastanoi* pv. *glycinea* is *Glycine max* (soybean). Following artificial inoculation, Psg can be re-isolated from *Phaseolus lunatus* (lima bean), *P. vulgaris* (bush bean), *P. acutifolius* (tepary bean), *Vigna uniguiculata* (cowpea), *Vigna angularis* (azuki bean), along with the weeds *Pueraria lobata* (kudzu), *Amaranthus retroflexus* (red-root pigweed), and *Solanum nigrum* (black nightshade) (Bradbury, 1986; Bogatsevska, 1990; Völksch and Weingart, 1997).

Symptoms: Bacterial blight is usually one of the earliest foliar diseases to appear on soybean. Brown spots can develop on the margins of the cotyledons and young plants can be stunted or even killed if the infection reaches the growing point. Symptoms begin in the upper canopy on young leaves, which are most susceptible. Small, angular, reddish-brown lesions develop that are surrounded by a yellowish-green halo. As the disease progresses, lesions can merge to produce large, irregularly shaped dead areas. The centers of older lesions frequently fall out, causing leaves to appear tattered. Bacterial blight occurs on all above ground plant parts but is most prevalent on leaves in the mid to upper canopy. Infected leaves usually remain on the plant. Infection can also occur on stems, petioles, pods, and seeds in infected pods. Infected seedlings may be stunted or killed in severe cases (Giesler, 2011).

Bacterial blight can be mistaken for septoria brown spot, a disease caused by the fungus, *Septoria glycines*, and bacterial pustule, caused by *Xanthomonas axonopodis* pv. *glycines*. Psg can be distinguished from these diseases because it is the only one with a yellow halo around the blight lesions. These diseases can co-occur on the same plants, but Psg is most common on young leaves and

causes tattering. Bacterial pustule causes circular spots with elevated centers, and brown spot is usually seen on older, lower leaves in the plant (Giesler, 2011).

Transmission: Cool, wet weather and rainstorms favor disease epidemics. Disease progress stops in dry, hot conditions. Psg is spread by wind and rain and by any cultivation of the crop when foliage is wet. It survives winters in crop residue and in seed. It can survive on leaf surfaces as an epiphyte and infects plants when conditions are suitable. Infection occurs through stomates and wounds caused by wind, hail, or insect feeding. Outbreaks are common after rainstorms with high winds (Giesler, 2011).

Damage Potential: Bacterial blight seldom causes serious yield loss due to the use of resistant varieties. Historical yield losses were estimated at 4 to 40% in the U.S. (Wrather and Koenning, 2009). This disease has not been detected in California, where there is very limited soybean cultivation. Although there are other susceptible legumes and weeds, damage to them has not been reported. New races of Psg with the ability to overcome host resistance genes are a possibility in the future.

Worldwide Distribution: America: *Argentina, Brazil, Canada, Colombia, Mexico, United States of America* (Alabama, Delaware, Florida, Hawaii, Illinois, Iowa, Minnesota, Missouri, Nebraska, North Carolina, North Dakota, Ohio, Wisconsin), *Venezuela*. Asia: *Brunei Darussalam, China, India, Indonesia, Japan, Kazakhstan, Republic of Korea, Mongolia, Pakistan, Philippines, Taiwan*. Europe: *Austria, Bulgaria, France, Germany, Hungary, Italy, Moldova, Poland, Romania, Russia, Serbia, Ukraine*. Oceania: *Australia, New Zealand*

Official Control: Quarantine pest in Mexico (EPPO, 2020). USDA-PCIT harmful organism list for Ecuador Honduras, Mexico, Nicaragua, Panama, and Peru (USDA, 2020).

California Distribution: None

California Interceptions: None

The risk *Pseudomonas savastanoi* pv. *glycinea* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Disease development is favored by cool, wet spring climates.

   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 natural host range is limited to soybeans. Some other legumes and weeds can be artificially inoculated.

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 spreads with wind and rain. It can also be spread with infected 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:** Due to the use of resistant varieties, yield losses are rarely reported from this pathogen.

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

Economic Impact:

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:** The disease seems to be limited to soybeans in commercial cropping systems.

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 savastanoi* pv. *glycinea:* Low

Add up the total score and include it here. **7**
-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'. There is one pest detection record listed as P. *syringae* pv. *glycinea* in the CDFA data base from Monterey County. It was isolated from bean pods. The identification predates the level of phylogenetic analysis of multiple genetic loci that is currently standard to reliably separate pathovars. Thus, I cannot be certain if this pathovar designation is correct.

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 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 *Pseudomonas savastanoi* pv. *glycinea* is C.

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Responsible Party:

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***Comment Period: 11/24/2020 through 01/08/2021**

***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