

California Pest Rating Proposal for

Potato leafroll virus

Current Pest Rating: C

Proposed Pest Rating: C

Domain: Virus; Realm: Riboviria; Kingdom: Orthornavirae;
Phylum: Kitrinoviricota; Class: Tolucaviricetes; Order: Tolivirales;
Family: Luteoviridae; Genera: Polerovirus

Comment Period: 10/26/2020 through 12/10/2020

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 Potato leafroll virus is given herein and a permanent pest rating is proposed.

History & Status:

Background: Potato leafroll virus (PLRV) causes one of the most important viral diseases of potatoes. The disease affects both the yield and the quality of tubers. Plants may show only a slight paleness (chlorosis) or anthocianescence (purpling) and slight leafrolling of the leaflets. They may not show any foliar symptoms, but their tubers will be small with internal symptoms of net necrosis, which reduces their market value. Yield losses in highly susceptible varieties can be 40-70% (Jayasinghe, 1988).

PLRV virions are extremely small with diameter of approximately 24 nm. Nearly spherical viral particles contain positive-sense genomic RNA. It infects potatoes and other members of the family Solanaceae. PLRV was first described by Quanjer et al. in 1916 and today it is the type species in the genus *Polerovirus* for **Potato leafroll**. PLRV is transmitted by aphids, primarily by the peach-potato aphid, *Myzus persicae* (Agrios, 2005).

Hosts: Capsella bursa-pastoris (shepherd's purse), *Capsicum annuum* (bell pepper), *Corchorus olitorius* (jute), *Fritillaria thunbergii* (Thunberg's fritillary), *Sisymbrium altissimum* (Tall rocket) *Solanum acaule* (wild potato), *Solanum lycopersicum* (tomato), *Solanum phureja* (nightshade), *Solanum tuberosum* (potato), *Ullucus tuberosus* (ulluco) (CABI-CPC, 2020).

Symptoms: Symptom expression in potatoes depend on the virus strain, variety, environment, the timing and the source of infection. Plants produced from diseased seed tubers are the most severely affected. They show symptoms first on lower leaves. Typically, the plants are stunted and appear more erect with severe upwards rolling of lower leaflets at the margins. The leaves have a stiff, leathery texture. The leaflets may die prematurely. In contrast, plants that become infected in the current season by aphid vectors normally develop symptoms in the upper (youngest) leaves first; the leaves develop an upright orientation, become chlorotic and purple, and roll upwards. Late-season infections do not always cause symptoms. In some varieties, phloem becomes necrotic and carbohydrates accumulate in the leaves. There is phloem necrosis in tubers also that causes necrotic netting or net necrosis, which is small brown speckles or strands of discolored tissue that start at the tuber's stem end and which may extend as far as halfway through the tuber in tuber vascular tissue of some varieties, including Russet Burbank. (Nunez and Aegerter, 2019; Agrios, 2005). Net necrosis can develop without foliar symptoms when plants are infected after leaves have stopped growing but tuber expansion continues. Incidence of net necrosis can increase during prolonged storage, especially for smaller sized tubers (Pscheidt and Ocamb, 2019). Net necrosis can be confused with zebra chip disease, which is caused by Candidatus *Liberibacter solanacearum*

Transmission: Transmission of PLRV requires an aphid vector. The transmission process is unlike that of potyviruses, which are rapidly acquired and immediately spread by aphid probing and feeding but are non-persistent. In contrast, transmission in PLRV is a circulative–non propagative mechanism where the aphid must acquire the virus by feeding on the phloem of a PLRV infected plant for at least 20 minutes. The virus must circulate from the gut of the aphid, through the circulatory system, until it gets into the salivary glands to be excreted when the aphid feeds on healthy plants. This may take 24 hours or more from feeding to the point at which the virus can be transmitted. Once an aphid acquires PLRV, it can remain infectious for days to weeks and even after molting (Day, 1955; Jayasinghe, 1988).

Spread of the virus between fields happens with winged forms of the aphid, but most localized spread within a field is accomplished by the movement of wingless forms. Studies have demonstrated that PLRV infection increases the attractiveness of the plants to aphids (Ngumbi et al., 2007). Long-distance dissemination of PLRV occurs mainly through the distribution of infected potato seed tubers (CABI-CPC, 2020).

Damage Potential: PLRV is one of the most serious and damaging viruses of potatoes. It causes severe yield losses (up to 90%) and in some cultivars also reduces the quality of the tubers because of the net necrosis (Jeffries, 1998). Control of PLRV is based primarily on the use of virus-free or certified seed potatoes where tolerance levels for infection are set between 0.5% and 5% (Slack and Singh, 1998). PLRV can be moved into healthy potato crops by aphids that have acquired the virus from infected weeds or volunteer potatoes (Stevenson et al., 2001). Early warning programs that forecast increases in aphid populations can be helpful in timing insecticide treatments. Alternatively, insecticides are used in early and mid-season. Full plant resistance to PLRV is not available in popular varieties, but many available varieties do not develop tuber net necrosis (Nunez and Aegerter, 2019)..

Worldwide Distribution: Africa: *Algeria, Kenya, Morocco, South Africa, Sudan, Tanzania, Tunisia.* Asia: *Bangladesh, China, India, Iran, Israel, Japan, Lebanon, Pakistan, South Korea, Syria, Turkey.* Europe: *Bulgaria, Cyprus, Czechia, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Serbia, United Kingdom.* North America: *Canada, Costa Rica, Cuba, Dominican Republic, Greenland, Mexico, Saint Kitts and Nevis, United States (Alaska, Idaho, Maine, Minnesota, New York, North Dakota, Oregon, Pennsylvania, Utah, Washington).* Oceania: *Australia, New Zealand.* South America: *Argentina, Bolivia, Brazil, Colombia, Guyana, Peru.*

Official Control: PLRV is on the USDA-APHIS' harmful organism list for Albania, European Union, Egypt, Georgia, Honduras, Iceland, Japan, Jordan, Moldova, Monaco, Nicaragua, San Marino, Serbia, and Vatican city state (USDA -PCIT, 2020). It is an EPPO quarantine pest in Mexico and Norway, on the A1 list for the European Union, and on the A2 list for Argentina, Bahrain, Jordan, and Turkey (EPPO, 2020).

California Distribution: Kern, Orange, Riverside, San Benito, San Diego, San Joaquin, San Mateo, Santa Barbara, Santa Clara, Siskiyou, and Tulare counties (French, 1989; CDFA PDR Database).

California Interceptions: none

The risk Potato leafroll virus would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This pathogen survives inside of its hosts and inside aphid vectors. It could establish anywhere in California where its hosts are grown.

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.**
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2) Known Pest Host Range: The host range includes cultivated plants and weeds from multiple 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: This virus multiplies inside of, and is dispersed by, winged aphid vectors over short to moderate distances. Long distance spread is with the movement of infected seed tubers.

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: The most damage from this virus has been reported on potatoes. Infected plants produce tubers that are smaller and may show symptoms of net necrosis. It is vectored by multiple species of aphids, and control of aphids is important to disease management. A high level of disease control is obtained by testing and certification of virus free tubers for planting.

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

Economic Impact: A, E

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: PLRV can infect weed hosts and volunteer potatoes. These are sources of viral inoculum to field crops and necessitate insecticide applications at planting, before aphid pressure is evident (Mondal et al, 2017).

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: 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 Potato leafroll virus: Medium

Add up the total score and include it here. **12**

-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'. Although many of the records are decades old, potato leafroll virus has been reported from multiple hosts in a dozen counties statewide

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)
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Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 9*

Uncertainty: None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Potato leafroll virus is C.

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Responsible Party:

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***Comment Period: 10/26/2020 through 12/10/2020**

***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.
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Proposed Pest Rating: C
