

California Pest Rating Proposal for

Tobacco rattle virus

Spraing of potato

Current Pest Rating: C

Proposed Pest Rating: C

Kingdom: Viruses and viroids, Category: Riboviria

Family: Virgaviridae, Genus: Tobravirus

Comment Period: 08/10/2021 through 09/24/2021

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Tobacco rattle virus is described herein and a permanent pest rating is proposed.

History & Status:

Background: Tobacco rattle virus (TRV) is the type species of the genus **Tobravirus**. This genus is in the family Virgaviridae, which holds seven genera of rod-shaped plant viruses with positive sense single-stranded RNA. TRV was first described on tobacco in the 1930s and has been found in many parts of the world including Europe, North America, Japan, and Brazil. It has a notably wide host range, infecting more than 100 species naturally and more than 400 species experimentally, although not all of these infections are systemic, and some are asymptomatic.

Tobraviruses are transmitted mechanically and by soil-borne nematodes in the genera *Nanidorus*, *Paratrichodorus* and *Trichodorus* (Trichodoridae). These genera are common and widespread in California and are C-rated <https://blogs.cdfa.ca.gov/Section3162/?p=6389> (Chitambar et al., 2018). Weeds have an important role in the maintenance and spread of tobraviruses, with *Capsella bursa-pastoris*, *Senecio vulgaris*, *Stellaria media*, and *Viola arvensis* being the most common weed hosts. Seed transmission has also been reported.

The major diseases caused by TRV include those of potato and ornamental bulbs (narcissus, gladiolus, tulip, lily, and crocus). In California, most detections have been made from lettuce, tomatillo and spinach. TRV infection in potato leads to the formation of arcs and flecks of brown corky tissue in the

tuber, which is referred to as “spraing”, and which reduces their value. Even symptomless infections lead to significant reductions in tuber yield. Symptomless seed potatoes are high risk for spreading the disease.

In 1977, CDFA plant pathologists D. Mayhew and T. Matsumoto published a first report of TRV infecting romaine lettuce in San Luis Obispo, Santa Barbara and Ventura counties. A possible vector, the stubby root nematode *Paratrichodorus christiei*, was present in the soil (Walkinshaw et al., 1961). This was followed by a first report in spinach in 2010 by Koike et al.

Hosts: TRV has a very large host range with over 100 naturally infected hosts and more shown to be susceptible by inoculation. Many of these hosts are symptomless and the virus often remains localized to the roots, bulbs or tubers of infected hosts. Hosts include: *Allium cepa* (onion), *Allium sativum* (garlic), *Alstroemeria* (Inca lily), *Amaranthus* (amaranth), *Anemone* (windflower), *Aquilegia* (columbines), *Artemisia* (wormwoods), *Artemisia vulgaris* (mugwort), *Beta vulgaris* var. *saccharifera* (sugarbeet), *Brassica* sp., *Capsella bursa-pastoris* (shepherd's purse), *Capsicum annuum* (bell pepper), *Cyclamen*, *Cynara cardunculus* var. *scolymus* (globe artichoke), *Daucus carota* (carrot), *Dicentra spectabilis* (bleeding heart), *Fraxinus* (ashes), *Freesia*, *Galium mollugo* (hedge bedstraw), *Gladiolus* hybrids (sword lily), *Hosta* spp., *Iris* (irises), *Lactuca sativa* (lettuce), *Lamprocapnos spectabilis*, *Lilium candidum* (madonna lily), *Lilium longiflorum* (Easter lily), *Malva* (mallow), *Mentha* sp. (mint), *Narcissus* (daffodil), *Nicotiana tabacum* (tobacco), *Paeonia* (peonies), *Paeonia lactiflora* (Chinese peony), *Peperomia*, *Phaseolus vulgaris* (common bean), *Phlox*, *Phlox paniculata* (summer perennial phlox), *Physalis* (groundcherry), *Plantago* (plantain), *Portulaca oleracea* (purslane), *Rumex* (dock), *Secale cereale* (rye), *Sedum* (stonecrop), *Solanum nigrum* (black nightshade), *Solanum tuberosum* (potato), *Sonchus* (sowthistle), *Spinacia oleracea* (spinach), *Stellaria media* (common chickweed), *Tulipa* (tulip), *Tussilago farfara* (colt's-foot), *Viola arvensis* (field pansy) (CABI-CPC, 2021).

Symptoms: On romaine lettuce, symptoms include stunted and flattened growth accompanied by brilliant chrome-yellow ringspot and line patterns on the leaves. Similar symptoms can occur on head lettuce, peppers, tomatillo, and potato (Mayhew and Matsumoto, 1977). On spinach, symptoms are a general chlorosis and bright yellow botches and spots, leaf crinkling, and occasionally necrotic spots (Koike et al., 2010). On potato, there are rarely any aboveground symptoms. Tuber symptoms are variable based on variety, temperature, time of infection and viral strain. They can be external, as arcs of discolored tissues, especially on smooth skin cultivars. Internal symptoms are small flecks, necrotic rings or large necrotic/corky areas (Nunez and Aegerter, 2019).

Transmission: TRV is transmitted by stubby root nematodes (*Paratrichodorus* spp., *Trichodorus* spp., *Nanidorus* spp.). Ayala and Allen (1968) tested four stubby root nematode species for their ability to transmit California strains of Tobacco rattle virus (TRV). *Paratrichodorus allius* was a good vector and was used in all experiments on nematode-virus interrelationships, whereas *Nanidorus minor* and *P. porosus* were moderately good vectors. The nematodes have a semi-persistent but a non-replicative process, where virus particles are transferred to the host plant through vector feeding on root epidermal and root hair cells. At the beginning of the feeding cycle, the juvenile or adult nematodes puncture multiple individual cells with its onchiostylet. The nematodes begin sucking up the plant cell

cytoplasm. During the feeding process, Tobravirus is absorbed and is assimilated into the nematodes. Eventually, the nematode loaded with Tobravirus starts its feeding cycle on uninfected root. During this period, Tobravirus will be transferred into the new cell, completing the virus transmission (Otulak et al., 2012; Karanastasi, and Brown 2004). Movement can occur short distances as nematodes migrate, or larger distances with the movement of nematodes, soil, and water. Seed potato tubers and infected seeds are likely responsible for the movement of the virus over long distances. Many weeds can be hosts of the virus and nematode vector and serve as overwintering inoculum for annual crops (CABI-CPC, 2021).

Damage Potential: TRV has a negative effect on the marketability of lettuce because heads fail to meet shipping size requirements (Mayhew and Matsumoto, 1977). For spinach, symptomatic plants are unmarketable leaving affected areas unharvested (Koike et al., 2010). Potato fields with a history of disease may need to be fumigated to kill the nematode vectors (Nunez and Aegerter, 2019).

Worldwide Distribution: *Africa:* Egypt, South Africa, Tunisia. *Americas:* Brazil, Canada, Cuba, United States (Alaska, California, Colorado, Florida, Idaho, Illinois, Indiana, Massachusetts, Michigan, Minnesota, Nebraska, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Utah, Washington, Wisconsin). *Asia:* Bangladesh, China, India, Japan, Uzbekistan. *Europe:* Austria, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Moldova, Netherlands, North Macedonia, Norway, Poland, Russia, Serbia, Sweden, Switzerland, United Kingdom. *Oceania:* Australia, New Zealand (EPPO, 2021).

Official Control: Tobacco rattle virus is on the EPPO's A1 list for Argentina, Bahrain, Brazil, Paraguay, and Turkey; A2 list for Jordan, and a Quarantine pest for Canada, Israel, Mexico, and United States. It is on USDA PCIT's harmful organism list for Argentina, Brazil, Canada, Colombia, Dominican Republic, Ecuador, French Polynesia, Georgia, Guatemala, Honduras, India, Israel, Japan, Republic of Korea, Mexico, Nicaragua, Oman, Panama, Peru, South Africa, Syrian Arab Republic, Taiwan, Thailand, Turkey, and United Arab Emirates. Tobacco rattle virus is an approved additional request for CDFA field inspection for phytosanitary certification of export seeds for onions and peppers.

California Distribution: There are official records from Kern, Monterey, Sacramento, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Tulare, and Ventura counties (French, 1989, CDFA PDR database, 2021).

California Interceptions: None

The risk Tobacco rattle virus would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This virus and its vectors are widely distributed in California; the disease can occur wherever susceptible 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.**

- 2) Known Pest Host Range:** The host range of this virus is very large and diverse.

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:** The virus can only multiply inside a susceptible host. The nematode vector moves very slowly under natural conditions. It can also be seed borne in some hosts which increases dispersal potential.

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:** Economic damage has been reported on multiple hosts. Leafy vegetables and ornamentals are damaged by the general appearance of viral symptoms on their leaves, and a decrease in yield. Potato tubers are damaged by the spraing symptoms and should not be used as seed.

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

Economic Impact: A, B, 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.
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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: With a wide host range, this virus is established in perennial weeds and native plants in California.

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

Environmental Impact: A

- 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 Tobacco rattle virus: High

Add up the total score and include it here. **14**

- 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.

There are official detections in multiple counties from Siskiyou in the north to Kern in the south, and along the coast from Santa Clara to Ventura, with reports dating back at least 50 years.

Evaluation is 'high'.

Score: -3

- Not established (0) Pest never detected in California or known only from incursions.
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-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 = 11

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Tobacco rattle virus is C.

References:

Ayala, A., and Allen, M. W. 1968. Transmission of the California tobacco rattle virus (CTRV) by three species of the nematode genus *Trichodorus*. *Journal of the Agricultural University of Puerto Rico*, 52, 101–125.

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Paulus, A.O., Weathers, L. and Thomason, I. 1963. A soil-borne virus disease of pepper in California. In Phytopathology (Vol. 53, No. 8, p. 885).

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Responsible Party:

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***Comment Period: 08/10/2021 through 09/24/2021**

*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](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
