

California Pest Rating Proposal for Tomato black ring nepovirus

Current Pest Rating: None

Proposed Pest Rating: A

Kingdom: Viruses and viroids, Category: Riboviria,
Category: Orthornavirae, Phylum: Pisuviricota,
Class: Pisoniviricetes, Order: Picornavirales,
Family: Secoviridae, Genus: Nepovirus

Comment Period: 10/05/2022 through 11/19/2022

Initiating Event:

This pathogen has not been through the current pest rating process. The risk to California from Tomato black ring virus (TBRV) is described herein and a permanent rating is proposed.

History & Status:

Background: Tomato black ring virus was first described in the United Kingdom by Smith in 1946. The virus was initially isolated from tomato fruit. However, TBRV is rarely found in tomato and tomato is not considered an economically important host (Martelli and Taylor, 1990). TBRV infects a wide range of economically important crop species as well as many weed and ornamental species. One of the most important hosts is strawberries, followed by cucurbits (Brundt et al., 1996). In 2020, strawberries were grown on 33,100 acres mainly in coastal counties with a total value of nearly \$2B (CDFA Ag Stats, 2021) (https://www.cdfa.ca.gov/Statistics/PDFs/2021_Ag_Stats_Review.pdf).

Tomato black ring virus (TBRV) is a member of subgroup B of the genus *Nepovirus*. It has a broad host range and is transmitted by seed, pollen, and ectoparasitic nematodes. TBRV is common in Europe and has been reported from several other continents. However, natural spread appears to occur only in Europe (CABI, 2022). TBRV is transmitted by species of nematode in the genus *Longidorus*, including *L. elongatus*, a B-rated species of limited distribution in California (Chitambar, 2015; Nemaplex, 2022; Chitambar et al., 2018).

Hosts: The major host for this virus is *Fragaria* spp. (strawberry). Minor hosts: *Allium ascalonicum*

(shallot), *Allium cepa* (onion), *Apium graveolens* (celery), *Arctium zuppu*, *Asparagus officinalis* (asparagus), *Beta vulgaris* (beet), *Brassica napobrassica* (swede), *Brassica napus* (rape), *Brassica oleracea* (cabbage), *Brassica rapa* (turnip), *Capsella bursa-pastoris* (shepherd's purse), *Capsicum annuum* (chili pepper), *Cerastium vulgatum* (big chickweed), *Clematis* spp. (clematis), *Crocus* spp. (crocus), *Cucumis sativus* (cucumber), *Cucurbita pepo* (zucchini), *Cynara cardunculus* (artichoke), *Cynara scolymus* (globe artichoke), *Daucus carota* (carrot), *Fumaria officinalis* (fumitory), *Geranium dissectum* (cutleaf geranium), *Heracleum sphondylium* (hogweed), *Hosta* spp. (hosta), *Lamium amplexicaule* (henbit deadnettle), *Lamprocapnos spectabilis* (bleeding hearth), *Lactuca sativa* (lettuce), *Lolium perenne* (perennial ryegrass), *Lycopsis arvensis* (wild bugloss), *Medicago sativa* (alfalfa), *Myosotis arvensis* (field forget-me-not), *Narcissus pseudo-narcissus* (daffodil), *Pastinaca sativa* (parsnip), *Pelargonium* spp. (geranium), *Petroselinum crispum* (parsley), *Phlox* spp. (phlox), *Polygonum* spp. (knotgrass), *Prunus dulcis* (almond), *Prunus persica* (peach), *Pyrus* spp. (pear), *Rheum rhabarbarum* (rhubarb), *Ribes* spp. (currant), *Robinia pseudoacacia* (black locust), *Rubus idaeus* (raspberry), *Rubus* spp. (blackberry), *Sambucus nigra* (elder), *Senecio vulgaris* (groundsel), *Solanum lycopersicum* (tomato), *Solanum tuberosum* (potato), *Sonchus asper* (sow thistle), *Sorbus aucuparia* (mountain ash), *Spergula arvensis* (corn spurry), *Spinacia oleracea* (spinach), *Stellaria media* (common chickenweed), *Taraxacum officinale* (common dandelion), *Trifolium repens* (white clover), *Tulipa geseneriana* (tulip), *Tussilago farfara* (coltsfoot), *Urtica urens* (annual nettle), *Veronica agrestis* (speedwell), *Veronica persica*, and *Vitis vinifera* (grapevine) (EPPO, 2022).

Symptoms: The symptoms of TBRV on strawberries vary depending upon the cultivar and the time of year and commonly consist of blotches and necrotic ring spots on leaves. In some cultivars that are highly susceptible, there can be stunting and dwarfing, and plants may die. In others that are tolerant, infected plants may be asymptomatic or may appear to recover, but these plants can serve as a reservoir for infection of other plants (Converse, 1987; Martin and Tzanetakis, 2006).

In raspberries, susceptible cultivars show chlorotic mottling, vein yellowing, yellow speckling, yellow or chlorotic ringspot, leaf curling, reduced vigor, stunting, and deformation of fruit (Martelli and Taylor, 1990). In artichokes, there are chlorotic ringspots on the leaves, a decrease in the weight of the inflorescence and fewer inflorescences per plant (Gallitelli et al., 2004). In celery, symptoms can be restricted to a few yellow flecks, all the way to an intense yellow vein banding around the major veins, sometimes involving the entire leaf lamina (Hollings, 1965). In potato, symptoms include leaf necrosis and stunted shoots (Harrison, 1959). Common symptoms in other hosts including cucurbits have been studied and include chlorotic spotting, mosaic symptoms, necrotic lesions, ring spots or pattern lines, and deformed fruit (Pospieszny et al., 2005). Symptoms in grapevines are leaf degeneration which damages vine vigor and fruit quality (Laveau et al., 2019).

Transmission: TBRV is known to be transmitted by two nematode species, *Longidorus attenuatus* and *L. elongatus* (Harrison et al., 1961). These nematodes feed ectoparasitically on the roots of host plants. Nepoviruses transmitted by *Longidorus* spp. are usually associated with the odontostyle (stylet) and

can remain infective inside the nematode for up to nine weeks (Sanfaçon, 2009). Nepoviruses are generally restricted by the distribution of their nematode vectors. The spread of nematode-transmitted viruses through an infected field is often slow and occurs in patches. TBRV infection can cause few or no symptoms in the early stages of infection (Converse, 1987). In addition to nematode transmission, TBRV is also transmissible by pollen and seed in more than 24 species in more than 15 plant families, with most infected seedlings found to be asymptomatic (Lister and Murrant, 1967). Long distance spread is through the movement of infected planting materials and seeds (CABI, 2022).

Damage Potential: Highly sensitive strawberry cultivars can be killed by TBRV infection in 1-2 years (Converse, 1987). Tolerant varieties can be a source of persistent inoculum in strawberry production areas, as can many types of weeds. Since the middle of the last century, there have been reports of significant damage caused by TBRV infection to several other important hosts. Whereas these reports are mostly old and infrequent, there is potential for this virus to cause damage in a wide range of economically important host plants. One report showed a disease incidence of 50% in an infected celery field (Hollings, 1965). Another report showed incidence of 5-39% in heavily infected potato fields (Harrison, 1959). Yield loss in an infected artichoke field was reported to be 40% (Gallitelli et al., 2004). The infection rate in one grape vineyard, in contrast, was found to be only 0.95% (Kominek, 2008).

Tomato black ring virus is listed as a harmful organism in a dozen countries, including many United States trading partners (e.g., Brazil, Canada, China, European Union, India, Japan, Mexico, Taiwan, and the United Kingdom). There may be trade implications with these countries, especially for export seed, if TBRV becomes established in California.

Worldwide Distribution: Asia: *India, Japan, Saudi Arabia*. Europe: *Albania, Belarus, Belgium, Bulgaria, Croatia, Czechia, Finland, France, Germany, Greece, Hungary, Ireland, Lithuania, Moldova, Netherlands, Norway, Poland, Russia, Serbia, Slovakia, Sweden, Switzerland, Turkey, United Kingdom* (CABI, 2022).

Official Control: TBRV is on the EPPO's A1 list for Argentina, Brazil, Chile, A2 list for Jordan and Turkey, Quarantine pest for Canada, Israel, Mexico, Norway, Tunisia, and United States. It is a regulated non quarantine pest in the United Kingdom (EPPO, 2022). It is on the USDA PCIT's harmful organisms list for Albania, Argentina, Brazil, Canada, Chile, China, Colombia, Cuba, Ecuador, European Union, Georgia, Guatemala, Holy See (Vatican City State), Honduras, India, Japan, Madagascar, Mexico, Monaco, Morocco, Namibia, New Zealand, Nicaragua, Panama, Peru, Republic of North Macedonia, San Marino, Serbia, South Africa, Syrian Arab Republic, Taiwan, Thailand, Islamic Republic of Iran, Republic of Korea, Republic of Turkey, Tunisia, and Uruguay (USDA PCIT, 2022).

California Distribution: None

California Interceptions: None

The risk Tomato black ring virus would pose to California is evaluated below.

Consequences of Introduction:

- 1) **Climate/Host Interaction:** TBRV is likely to be able to survive anywhere its hosts can grow.

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 of this virus is large, with agronomic, ornamental, and weedy hosts in multiple families.

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:** TBRV is a nepovirus that can spread with infected planting material, seed, pollen and be vectored by *Longidorus* nematodes.

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:** TBRV is a significant plant pathogen which infects a wide range of economically important crops. It is on the harmful organism list for multiple countries and an important pest for export vegetable seeds. The nematode vector can be spread with irrigation water.

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

Economic Impact: A, C, E, G

- 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: 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:** This pathogen could have a significant impact on cultural practices if infected nematodes are found. It can also impact home/urban and ornamental plantings.

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

Environmental Impact: E

- 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 Tomato black ring virus: High

Add up the total score and include it here. **13**

- Low = 5-8 points
 - Medium = 9-12 points
 - High = 13-15 points**
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- 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'. 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 = 13

Uncertainty:

TBRV is often found in mixed infections with raspberry ringspot virus (RpRSV) in strawberry (Converse et al., 1987). Both viruses are vectored by *L. elongatus*, and they exhibit similar symptoms in strawberry (Martin and Tzanetakis, 2006). Damage is greater when both viruses are present in infected strawberry (Converse et al., 1987; Martelli and Taylor, 1990).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Tomato black ring virus is A.

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Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

***Comment Period: 10/05/2022 through 11/19/2022**

*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.
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- ❖ 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: A
