California Pest Rating Profile for

Tomato bushy stunt virus

Pest Rating: C

Kingdom: Viruses and viroids, Category: Riboviria,
Category: Orthornavirae, Phylum: Kitrinoviricota,
Class: Tolucaviricetes, Order: Tolivirales,
Family: Tombusviridae

Comment Period: 01/09/2025 through 02/23/2025

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Tomato bushy stunt virus (TBSV) is described herein and a permanent rating is proposed.

History & Status:

Background:

California ranks first in the nation in tomato production with over 80% of the domestic crop grown annually on 243,000 acres and with a value of $1.5B (CDFA Ag Stats: https://www.cdfa.ca.gov/Statistics/PDFs/2022-2023_california_agricultural_statistics_review.pdf). Most of the production is processing tomatoes grown in the Central Valley.

Tomato bushy stunt virus (TBSV) was first described from tomatoes in Ireland (Smith, 1935; Thomlinson et al., 1982). TBSV is the type member of the genus *Tombusvirus* within the family Tombusviridae (Hearne et al., 1990). Tombusviruses are small icosahedral viruses that possess plus-sense RNA genomes. All members are readily transmitted by mechanical inoculation and through plant material used for propagation. Some may be transmitted by contact and through seeds. These viruses are often found in natural environments, i.e. surface waters and soils from which they can be acquired without the assistance of vectors. Transmission by the chytrid fungus in the genus *Olpidium* and by beetles has also been reported for members of several genera in the family but not specifically for TBSV. Most reports of TBSV are from temperate rather than tropical climates.

Tomato bushy stunt virus is used as a model system to study virus–plant interactions (Yamamura, and Scholthof, 2005). In nature, TBSV isolates occur as different pathogenic strains that collectively infect multiple crop species, for example, tomato, pepper, artichoke, cherry, hop, grapevine, and some ornamentals. The virus is very stable in the soil. In California, it has only been found associated with lettuce and tomatoes.

Lettuce dieback, a soil-borne disease of lettuce, emerged in the 1990s to cause severe losses for lettuce production in the western United States. The disease was thought to be caused by TBSV and a second tombusvirus, Moroccan pepper virus, which were present in the affected plants (Wintermantel and Hladky, 2013). However, recent work in the Salinas Valley has implicated a third virus, likely a previously undescribed tospovirus, as the cause of lettuce dieback disease with the presence of TBSV as co-incidental rather than causative of the disease symptoms (W. Wintermantel, pers comm, 2024).

Hosts: Beta vulgaris var. *saccharifera* (sugarbeet), *Capsicum annuum* (bell pepper), *Cornus sanguinea* (dogwood), *Lactuca sativa* (lettuce), *Malus sylvestris* (crab-apple tree), *Nicotiana glauca* (tree tobacco), *Poa annua* (annual meadowgrass), *Prunus avium* (sweet cherry), *Pyrus communis* (European pear), *Solanum lycopersicum* (tomato), *Solanum mammosum* (nipplefruit nightshade), *Solanum melongena* (eggplant), *Stellaria media* (common chickweed), *Tolmiea menziesii* (pick-a-back plant), *Tulipa fosterana* hybrids, *Urtica urens* (annual nettle).

Symptoms: TBSV infection causes stunting, bushy growth, deformation, and necrosis in tomatoes (Gerik et al., 1990). Plants are small, with cupped leaves that curl downwards. The younger leaves are twisted and show tip necrosis. A proliferation of lateral shoots gives the “bushy” appearance. Lower leaves become chlorotic and can have a purple tinge (Davis et al., 2013). Symptoms are similar for eggplant (Makkouk et al., 1981) and pepper (Cherif and Spire, 1983). Fruits from infected plants develop necrosis and chlorotic blotching, resulting in serious economic damage such as yield loss and deterioration in the quality of commercial solanaceous crops grown in both greenhouses and fields.

Transmission: Natural transmission of TBSV is through seed and soil, apparently without a vector. TBSV can be transmitted by mechanical inoculation to a large number of experimental hosts (CABI, 2024). TBSV particles are very stable and reach high concentrations in infected tissues including in crop debris. The soil-borne nature of the virus and its tendency to remain localized in tissues, make it likely that a wider number of cultivated and wild plants are infected locally in the roots and do not show symptoms (Kegler and Kegler, 1980). In addition, tombusviruses are efficiently spread and can become established in diverse environments including soil and water (Tomlinson and Faithfull, 1984). There is no evidence of seed transmission in lettuce or tomato. TBSV can be found listed as transmitted by pepper seed (Edwardson and Christie, 1997), but no data or references to support seed transmission seem to be available. There is not sufficient evidence that tomato seed is a pathway for TBSV. Tomlinson and Faithful (1984) reported detecting the virus in symptomless tomato fruit and in seedlings from these fruits, but studies on seed transmission have not been published.

Damage Potential: Infection levels of 40 to 50% were recorded in tomato fields in Tunisia (Cherif and Spire, 1983) and Spain (Luis-Arteaga et al., 1996). Tomato fruits on infected plants are smaller in size than normal and show blotching, rings, line patterns, and chlorosis, and sometimes fruit setting is drastically reduced. These factors can greatly reduce the economic value of the crop or make it unacceptable for consumers. In the case of tomatoes in California, yield losses of 80% were reported from TBSV by Gerik et al. (1990), however, there are no modern reports of TBSV as a problem for California tomato production.

Worldwide Distribution: Africa: *Morocco*; America: *Argentina, Canada, Suriname, United States of America* (California, Colorado, Michigan, Pennsylvania); Asia: *Iraq, Japan, Republic of Korea*; Europe: *Austria, Italy, United Kingdom* (EPPO, 2024).

Official Control*:* Tomato bushy stunt virus is on the EPPO's A1 list for Bahrain, Brazil, and Chile, on the A2 list for Jordan, and a regulated quarantine pest in Canada, Israel, and Mexico (EPPO, 2024). It is on the USDA PCIT's Harmful Organisms list for Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Ecuador, French Polynesia, Guatemala, Honduras, India, Japan, Jordan, Mexico, Nicaragua, Panama, Syrian Arab Republic, Taiwan, Thailand, and The Republic of Korea (USDA PCIT, 2024).

California Distribution: TBSV is included on the list of widely prevalent viruses in California (https://www.prevalentviruses.org/index.cfm).

California Interceptions: none

The risk that Tomato bushy stunt virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The virus has been reported in diverse California climates.

   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 be established in a larger but limited part of California.
   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The virus has a relatively restricted natural host range, comprised primarily of vegetables and ornamentals. The experimental host range is very large.

   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: This virus can be spread with soil, water, and plant debris. It is not known to have a vector. There are some limited reports that it is seedborne in some hosts

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: Fruit yield and quality of tomatoes can be reduced by this virus. It has been described as one viral component in lettuce dieback disease. It can be spread with irrigation water.

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

Economic Impact: A, B, G

A. The pest could lower crop yield.
B. The pest could lower crop value (including increasing crop production costs).
C. The pest could trigger the loss of markets (including 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: None have been reported but it appears to be endemic in vegetable production fields in some regions of California including the Salinas Valley (W. Wintermantel, pers. Comm.).

Evaluate the environmental impact of the pest on 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 Tomato bushy stunt 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.

This virus has been present in California for many decades with detections in tomato and lettuce in distant counties.

Evaluation is 'high'.
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 the 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 =* ***9***

Uncertainty:

Older reports implicating TBSV as the cause of disease symptoms and yield losses in lettuce and tomato may be overstated. It is probable that many reports were the result of crops co-infected with TBSV and other viruses that were unknown at the time.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Tomato bushy stunt virus is C.**

References:

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Responsible Party:

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***Comment Period: 01/09/2025 through 02/23/2025**

***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.

Pest Rating: C