California Pest Rating Proposal for

Tomato necrotic spot ilaravirus

Current Pest Rating: Z

Proposed Pest Rating: C

Realm: Riboviria, Kingdom: Orthornavirae,
Phylum: Kitrinoviricota, Class: Alsuviricetes,
Order: Martellivirales, Family: Bromoviridae,
Genus: Ilarvirus

Comment Period: 05/31/2022 through 07/15/2022

Initiating Event:

In April 2022, CDFA received an information request from USDA-APHIS- PPQ's Plant Pest Risk Analysis Unit about the status of Tomato necrotic spot virus (ToNSV) in California. ToNSV was first described from symptomatic processing tomato plants in California in 2008 and was assigned a temporary Z-rating. The risk to California from ToNSV is described herein and a permanent rating is proposed.

History & Status:

Background:

California tomatoes were valued at nearly $1.2B in 2020, with California growing nearly 100% of the processing tomatoes in the United States. Processing tomatoes are grown in the San Joaquin and Sacramento Valleys, with production centered in Fresno, Yolo, San Joaquin, Kings, and Colusa counties. Significant production also occurs in Merced, Stanislaus, Solano, and Sutter counties. Processing tomatoes were valued at $895M with fresh market tomatoes (mostly greenhouse grown in Santa Barbara and Ventura Counties, plus field production in San Diego County) at $280M (CDFA crop statistics, 2020) https://www.cdfa.ca.gov/Statistics/PDFs/2020_Ag_Stats_Review.pdf.

The family Bromoviridae contains six genera of viruses: *Bromovirus, Cucumovirus, Ilarvirus, Alfamovirus, Anulavirus,* and *Oleavirus*. There are 22 described ilarviruses and they have been found primarily in woody plants. Notable members of the genus and their hosts include Apple mosaic virus (pome fruits and roses), Prunus necrotic ring spot virus and Prune dwarf virus (stone fruits and roses), and Citrus leaf rugose virus and citrus variegation virus (citrus) (Bujarski et al., 2019).

Ilarviruses are named after their description as "**i**sometric **la**bile **r**ingspot viruses," although they are not truly isometric and many cause symptoms other than ringspots. The type species Ilarvirus is tobacco streak. Several Ilarviruses can be transmitted by thrips, but some are seed and/or pollen transmitted in some hosts. Ilarviruses occur wherever their hosts are grown, and many are distributed worldwide having been spread with infected nursery stock, budwood, or seed. Because ilarviruses are very labile (unstable), they have been more difficult to isolate and characterize. Therefore, the identity of many and relationships with one another have been difficult to establish definitively.

ToNSV is most closely related to, but distinct from, Parietaria mottle virus (PMoV) which infects tomato, pepper and *Parietaria officinalis* (eastern pellitory-of-the-wall) in France, Greece, Italy, and Spain (Galipienso et al., 2005). The complete genomic sequencing has identified ToNSV as a new subgroup 1 ilarvirus distinct from the previously described tomato-infecting ilarviruses (Bratsch et al., 2019).

Hosts: Solanum lycopersicum (tomato). Field crops of symptomatic onions, peppers, and lettuce have also been shown to be infected with ToNSV (Batuman et al., 2009, 2011; Gilbertson and Batuman, 2013).

Symptoms: Foliar symptoms on tomatoes include necrotic spotting and flecking. Stems have necrotic streaking, and fruit develop an extensive pattern of necrotic concentric lines, spots, and scabbing. Symptoms are like those caused by another *Ilaravirus*, Tobacco streak virus (Batuman et al., 2008; Bratsch et al., 2018). In mechanical inoculation studies, terminal branches expressed the strongest symptoms with some becoming entirely necrotic. Stem symptoms included necrotic streaking. Fruit varied in the intensity and amount of surface area covered with symptoms, which included necrotic concentric rings, circles, and patches (Bratsch et al., 2018).

Transmission: There is evidence of transmission of ToNSV through infected pollen spread by the feeding of western flower thrips, *Frankliniella occidentalis* (Gilbertson et al., 2015). Western flower thrips is C-rated, common and widespread in California. Other ilarviruses are transmitted by seed and through thrips-mediated pollen transmission (Gilbertson et al., 2015). Tomatoes mechanically inoculated with infected sap developed symptoms in greenhouse studies done by Batuman et al., 2011. ToNSV has been detected in pollen collected from ToNSV-infected plants (Gilbertson et al., 2015).

Damage Potential: In California field grown processing tomatoes, symptoms have been observed in numerous fields in Merced, San Joaquin, and Yolo counties, though the incidence of the disease in most fields was not high (usually not more than 5% but occasionally over 20% in some areas) (Batuman et al., 2009). In high tunnel grown fresh tomatoes in Indiana, approximately 5% of the plants were found to be infected with ToNSV, with fruit showing patterns of necrotic concentric lines, spots, and scabbing, making them unsaleable (Bratsch et al., 2018). Higher disease incidences (up to 20% in some fields), is associated with high thrips populations (Batuman et al., 2011).

Varying rates of seed transmission of ilarviruses in tomatoes have been reported but in general are very low, less than 1% (Badillo-Vargas et al. 2016). PMoV can be transmitted by seed in *Parietaria*

officinalis plants at a rate of 36% but ToNSV has not been shown to be seed transmitted in tomato (Aramburu et al., 2010). In both Indiana and Ohio, a very low rate and sporadic distribution of ToNSV infection was reported across the crops. Further experiments are required to determine if ToNSV is seed transmitted in tomatoes or other crops, perhaps at a rate less than 1%, as observed with other tomato infecting ilarviruses.

Worldwide Distribution: This virus as only been reported in the United States (California, Batuman et al.; Ohio and Indiana, Bratsch et al., 2018).

Official Control: None

California Distribution: Merced, San Joaquin, and Yolo counties (Batuman et al., 2008), Sacramento County (CDFA PDR database).

California Interceptions: None

The risk Tomato necrotic spot virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This disease is likely to establish anywhere that tomatoes can grow in California

   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 primary host is tomatoes, but detections in peppers, onions and lettuce have been made in proximity to infected tomato fields, likely vectored by thrips.

   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:** The virus has a flying vector

   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:** This virus seems to cause a relatively low level of yield loss, around 5%. It is vectored by thrips. It is not a quarantine pest.

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**: None have been reported.

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: 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 necrotic spot virus*:* Medium

Add up the total score and include it here. **11**
-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 have been detections in the Sacramento and the San Joaquin valleys but not in Southern California.

   Evaluation is 'Medium'.

   Score: -2
   -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* ***= 9***

Uncertainty:

Tomato spotted wilt virus, Tobacco streak virus, Tomato necrotic streak virus, and Tomato apex necrosis virus, cause similar symptoms to ToNSV (Bratsch et al., 2019). It is not possible to diagnose this pathogen in the field.

It has been suggested that ToNSV is an indigenous virus naturally infecting a perennial plant host in California and that it is spreads to tomatoes when high levels of *F. occidentalis* are present (Gilbertson et al., 2015).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Tomato necrotic spot virus is C.**

References:

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Batuman, O., Miyao, G., Kuo, Y.W., Chen, L.F., Davis, R.M. and Gilbertson, R.L., 2009. An outbreak of a necrosis disease of tomato in California in 2008 was caused by a new ilarvirus species related to Parietaria mottle virus. Plant Disease, 93(5), pp.546-546.

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Gilbertson, R. L., and Batuman, O. 2013. Emerging viral and other diseases of processing tomatoes: biology, diagnosis and management. Acta Hortic. 971:35-48.

Responsible Party:

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***Comment Period: 05/31/2022 through 07/15/2022**

***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.

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
