

California Pest Rating Proposal for

Tomato leaf curl New Delhi virus

Current Pest Rating: none

Proposed Pest Rating: A

Kingdom: Viruses and viroids, Category: Monodnaviria,
Category: Shotokuvirae, Phylum: Cressdnaviricota,
Class: Repensiviricetes, Order: Geplafuvirales,
Family: Geminiviridae, Genus: Begomovirus

Comment Period: 07/18/2022 through 09/01/2022

Initiating Event:

This pathogen has not been through the pest rating system. Although it is not known to be seedborne, it is often requested in phytosanitary seed field inspections for cucurbits. The risk to California from Tomato leaf curl New Delhi virus (ToLCNDV) is described herein and a permanent rating is proposed.

History & Status:

Background: ToLCNDV was first described from India by Padidam et al. (1995) and today it is mainly reported in Asia and the Mediterranean regions. ToLCNDV has a broad host range encompassing Solanaceae, Cucurbitaceae, Fabaceae and Malvaceae species, many of which are important crops and ornamental plants as well as wild species (weeds). The main crop hosts of ToLCNDV are tomato and cucurbits, in particular zucchini, cucumber, and melon. Wild plant hosts may not show conspicuous symptoms but can serve as virus reservoirs. ToLCNDV sequences are sufficiently different from others named Tomato leaf curl virus to consider it a distinct virus species rather than a strain of another virus. ToLCNDV is seen as having evolved more recently compared to others that infect tomato in the Old World (Padidam et al., 1995).

ToLCNDV is in the genus *Begomovirus*, family Geminiviridae. Begomoviruses occur in the warmer parts of the world and infect only dicotyledonous plants ToLCNDV is a typical bipartite begomovirus whose genome consists of two circular ssDNA components, named DNA-A and DNA-B (Padidam et al., 1995) of 2.7 and 2.6 kb, respectively. DNA-A encodes all information for viral encapsidation and replication, produces virions, and can replicate autonomously. ToLCNDV has distinctive virus particles composed of

two incomplete icosahedra fused to form a paired (geminata) particle. These virus particles are unique and characteristic for geminiviruses only. Isolates of this virus can be grouped into several strains based on the molecular diversity of their DNA-A genome components (Moriones et al., 2017).

ToLCNDV is obligately transmitted by an insect vector, the sweet potato whitefly, *Bemisia tabaci*. This vector allows rapid and efficient spread of the virus because it is an indiscriminate feeder. The vector transmits in a persistent, circulative, non-propagative manner. Virus transmission by sap sucking is generally very effective and even a few viruliferous insects can cause disease outbreaks. *Bemisia tabaci* is a widespread C-rated pest in California, with a host range that include many herbaceous and some woody plants including cole crops, cotton, cucurbits, tomatoes, peppers, crape myrtle, lantana, roses, and hibiscus (Flint, 2015).

Hosts: Abelmoschus esculentus (okra), *Acalypha indica* (copperleaf), *Benincasa fistulosa* (round gourd), *B. hispida* (ash gourd), *Calotropis procera* (giant-milkweed), *Capsicum annuum* (sweet pepper), *C. chinense* (habanero pepper), *C. frutescens* (red chili), *Carica papaya* (papaya), *Catharanthus roseus* (bright-eyes), *Cestrum nocturnum* (night-jessamine), *Chenopodium album* (lamb's-quarters), *C. giganteum* (tree-spinach), *Chrysanthemum indicum* (Indian chrysanthemum), *Citrullus lanatus* (watermelon), *Coccinia grandis* (little gourd), *Commelina benghalensis* (dayflower), *Convolvulus arvensis* (bindweed), *Crossandra infundibuliformis* (firecracker-flower), *Cucumis melo* (melon), *C. melo* var. *flexuosus* (Armenian cucumber), *C. sativus* (cucumber), *Cucurbita ecuadorensis*, *C. foetidissima* (buffalo gourd), *C. fraternal*, *C. martinezii* (marten gourd), *C. maxima* (pumpkin), *C. moschata* (butternut squash), *C. pepo* (bitter bottle gourd), *C. pepo* var. *giromontiina*, *Cyamopsis tetragonoloba* (cluster-bean), *Dahlia pinnata* (dahlia), *Datura stramonium* (common thorn-apple), *Daucus carota* (carrot), *Ecballium elaterium* (squirting-cucumber), *Eclipta prostrata* (eclipta), *Euphorbia hirta* (garden spurge), *Glycine max* (soybean), *Gossypium hirsutum* (cotton), *Hibiscus cannabinus* (Deccan-hemp), *Jasminum multiflorum* (star jasmine), *Jatropha* (purgenut), *Lagenaria siceraria* (bottle gourd), *Lens culinaris* (lentil), *Luffa acutangula* (ribbed gourd), *L. aegyptiaca* (sponge gourd), *Momordica charantia* (bitter melon), *M. dioica* (spine gourd), *Papaver somniferum* (opium poppy), *Parthenium hysterophorus* (bitterweed), *Phyllanthus niruri* (niruri), *Physalis minima* (annual ground-cherry), *Ricinus communis* (castor-bean), *Rumex dentatus* (toothed dock), *Sauropus androgynus* (star-gooseberry), *Sechium edule* (chayote), *Solanum lycopersicum* (tomato), *S. melongena* (eggplant), *S. nigrum* (black nightshade), *S. tuberosum* (potato), *Sonchus oleraceus* (annual sow thistle), *Tagetes erecta* (marigold), *Trichosanthes cucumerina* (annual melon), *Trifolium repens* (white clover), *Vigna radiata* (celera-bean) (EPPO, 2022).

Symptoms: ToLCNDV symptoms may include from foliar yellowing or spotting, necrosis or mosaic on leaves, and leaf area reduction and stunting. In zucchini squash, ToLCNDV causes severe leaf curling, swelling of veins of young leaves, shortening of internodes, yellow mosaic in young leaves, roughness of the skin of fruit and reduced fruit size (Panno et al., 2016), reducing the marketability of the fruits. Symptoms appear 10 to 14 days after plants become infected as a result of vector feeding. ToLCNDV generates systemic infections in its hosts, with early signs such as leaf bending, deformation, and blistering observable in the youngest uppermost plant parts. This causes discoloration, chlorotic mottling, and vein banding in cucurbit hosts, followed by upward rolling and overall chlorosis of older

leaves. The earliest indicators of a developing begomovirus infection in tomatoes are leaf curving in the apical regions of the plant, which is comparable to the symptoms caused by Tomato yellow leaf curl virus (TYLCV) and other begomoviruses. Chlorotic patches and mottling might be seen on older leaves in later infestations. Early infections with ToLCNDV cause blooming and fruit development to be disrupted, resulting in fewer flowers and fruits. Fruits are undersized, with unsightly discoloration, indents or blisters, and a lack of flavor, and they may drop early, resulting in crop failure (EPPO, 2022).

Transmission: The occurrence of the virus coincides with the presence of the *B. tabaci* and the availability of suitable host plants. ToLCNDV occurs in areas where *B. tabaci* is endemic. Detections of ToLCNDV are also linked with the horticulture pathway and plants produced under protected cultivation, i.e., in greenhouses. Because of the broad host range and the polyphagous nature of its vector *B. tabaci*, the range of susceptible plant species may be larger than reported (EPPO, 2022).

Damage Potential: ToLCNDV is a danger to solanaceous and cucurbit plants, including commercially important crops like tomato, eggplant, pepper, potato, zucchini, cucumber, and melon. The virus causes significant economic losses in potato (Jeevalatha et al., 2017a, 2017b; Usharani et al., 2004), cotton and okra (Venkataravanappa et al., 2015, 2018; Zaidi et al., 2016), and many other food crops. ToLCNDV has a negative impact on the quality and yield of the crops.

In recent years, some begomoviruses have been spreading to temperate regions, becoming responsible for severe production losses (Navas-Castillo et al., 2011). ToLCNDV has been responsible for severe epidemic outbreaks in zucchini squash and for significant economic losses to cucurbit crops in Spain (López et al., 2015). The presence and rapid dispersal of ToLCNDV in the Mediterranean basin represents a threat for zucchini squash production, and other economically important crops such as tomato and pepper, as well as other Solanaceae and Cucurbitaceae crops. The number of new hosts of ToLCNDV increases every year (EPPO, 2022).

Worldwide Distribution: Africa: *Algeria, Morocco, Seychelles, Tunisia*; Asia: *Bangladesh, India, Indonesia Iran, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand*; Europe: *Greece, Italy, Portugal, Spain*.

Official Control: ToLCNDV is on USDA PCIT's harmful organism list for European Union, Morocco, Nicaragua, Peru, Republic of North Macedonia, Turkey, and the United Kingdom. It is on EPPO A1 list for Argentina and United Kingdom, it is an A2 Quarantine pest for the European Union and a Quarantine pest in Morocco.

California Distribution: None

California Interceptions: None

The risk Tomato leaf curl New Delhi virus would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** The vector, *Bemisia tabaci* is generally found in tropical and semitropical regions and vectors begomoviruses. They are found in all warmer parts of the state, and in greenhouses statewide.

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:** ToLCNDV is an unusual begomovirus as it has been reported from many different plants, including members of the Solanaceae, Cucurbitaceae and Malvaceae.

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:** With a large host range and a polyphagous flying vector, it has both high reproduction and 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:** This virus has spread quickly in the Mediterranean region causing significant losses, especially to squash. It is a quarantine pest in many countries and is vectored by plant-feeding whiteflies.

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

Economic Impact: A, C, 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 large host range, this virus has established itself in wild hosts (weeds) around agricultural fields.

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 Tomato leaf curl New Delhi virus: High

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

- 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 '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).
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-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:

none

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Tomato leaf curl New Delhi virus is A.**

References:

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Responsible Party:

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***Comment Period: 07/18/2022 through 09/01/2022**

***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.
 - ❖ 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
