

Tomato spotted wilt disease is caused by the *Tomato spotted wilt virus* (TSWV). This is not a new disease in California, but its incidence has been increasing in the Central Valley.

Currently, the virus is particularly damaging to pepper and tomato crops and is rapidly and specifically spread by thrips, predominantly the western flower thrips, *Frankliniella occidentalis*. This brochure provides basic information about TSWV biology and detection, and an integrated pest management (IPM) approach for California tomatoes.

DETECTION

Symptoms of TSWV infection in tomatoes are highly variable, and depend on the stage of growth when plants are infected, the cultivar, and environmental conditions. TSWV symptoms can also be confused with those caused by other viruses (e.g., curly top virus and *Alfalfa mosaic virus*). Thus, it is important to confirm suspected TSWV infections by providing samples to your county farm advisor or using a diagnostic immunostrip test. Results of these tests are quick (5-10 min.), and kits are available from companies such as AgDia (www.agdia.com) and EnviroLogix (www.envirologix.com).

SYMPTOMS

Infection at seedling or transplant stage.

Visually detecting the virus at this stage is the most challenging. Early infection of seedlings leads to extremely stunted growth. Infected plants may die. Leaves may curl, wilt, and develop yellowing/bronzing and necrotic spots or rings.



TSWV infection of a transplant.

Infection at early vegetative stages. Initial symptoms are leaf bronzing and wilting, followed by necrotic leaf spots and some degree of vein, stem, and petiole necrosis. Often the entire plant is off-color and leaves may have a crumpled appearance. Green fruit may develop bumps and show diagnostic concentric rings. As the tomatoes ripen on plants infected during early stages of growth, fruit may be distorted and have necrotic rings or etchings.

Infection at flowering through fruit set stage. Symptoms may develop in only one or two shoots. Initial

symptoms include leaf curling, pale green to yellow discoloration, and purpling. Fruit may be bumpy, deformed, and develop ringspots, blotches, and necrosis.

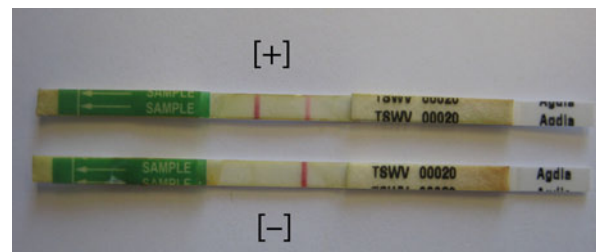
TSWV symptoms at all growth stages can be confused with curly top and alfalfa mosaic. However, if necrotic spots and rings develop on leaves, followed by necrosis and dieback of entire leaves or shoots, and especially if fruits have the symptoms described immediately above, TSWV is more likely the cause.



Symptoms of bronzing and necrosis.



Tomato transplant dying from TSWV infection.



Plant samples tested for TSWV infection with immunostrips. Positive (+) and negative (-) reactions are shown.



Purpling and leaf curling in a plant infected at a later stage of growth.



Bumpy fruit with ringspots on a plant infected at a later stage of growth.



Necrosis of shoots or "strikes."

HOST RANGE AND SPREAD

TSWV is a tospovirus (genus *Tospovirus*) in the *Bunyaviridae* family of viruses. TSWV is not transmitted via seed; it is primarily spread plant-to-plant by various species of thrips. The major thrips vector in California is the western flower thrips (*Franklinella occidentalis*). Thrips are tiny, slender insects about 1 to 2 mm long. The virus can only be acquired by immature thrips, and infected adults can transmit TSWV throughout their adult life (30-45 days). Adults do not pass the virus to their progeny.



Adult western flower thrips.

Although TSWV has a very wide host range, only TSWV-susceptible plants on which thrips can complete their entire life cycle play an important role in the disease cycle. In California, key crop hosts include tomato, pepper, lettuce, radicchio and fava bean.

Many weeds can be TSWV hosts; however, most are not important in the development of the disease. In California, important weed hosts include cheese-weed (*Malva parviflora*), sowthistle (*Sonchus oleraceus*), and prickly lettuce (*Lactuca serriola*). In general, the incidence of TSWV infection of these weeds is low, although occasionally high infection rates are found in weedy borders and fields, including fallow fields.

AN IPM STRATEGY FOR MANAGEMENT OF TSWV IN CALIFORNIA TOMATOES

Effective management requires an IPM approach that targets the thrips vector and the virus. This strategy can be divided into three parts:

Before the growing season:

- Prevent initial infections by planting TSWV-resistant tomato varieties with the Sw-5 gene. Insecticide control of thrips for TSWV control is generally not required for resistant varieties. Varieties without the Sw-5 gene differ in disease susceptibility.
- Use virus- and thrips-free transplants (from greenhouses that monitor thrips and inspect transplants).
- If thrips are present on transplants, manage populations prior to planting in the field.

During the growing season:

- Avoid planting near established fields of susceptible crops with confirmed TSWV infection. If this situation arises after planting, an early-timed thrips control program may be needed.
- Monitor fields for thrips (e.g., with yellow sticky cards) and TSWV symptoms.
- Manage thrips with insecticides at early stages of crop development when symptoms of tomato spotted wilt infection are observed and thrips are present to minimize spread of the virus within the field. Rotate chemicals to minimize the development of insecticide resistance in thrips.
- Consider removing plants if infected at the seedling stage to limit further spread.
- Control weeds in and around fields.

After the growing season:

- Promptly remove and destroy old tomato plants and other host crops/volunteers after harvest on a regional level.
- Control weeds/volunteers in fallow fields, non-cropped, or idle land near next year's tomato fields.

Some Insecticides for Thrips Management

Trade name (common name)	Resistance management class
Radiant (spinetoram) and Success (spinosad)	5
Dimethoate	1B
Lannate (methomyl)	1A
Beleaf (flonicamid)	9C
Mention of trade names is for illustration purposes only and is not an endorsement by UC Cooperative Extension or UC IPM.	

If you have additional questions or need assistance in testing for TSWV or developing thrips/TSWV management strategies, contact your county farm advisor or Robert L. Gilbertson at UC Davis (telephone: 530-752-3163 and e-mail: rlgilbertson@ucdavis.edu).



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TOMATO SPOTTED WILT DISEASE

Detection, Epidemiology, and Integrated Pest Management (IPM)



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