

Tomato spotted wilt disease of pepper (*Capsicum sp.*) is caused in California by *Tomato spotted wilt virus* (TSWV). It is not a new disease in California, and has been known since at least the 1980s. The incidence has been increasing throughout the Central Valley for the past 10-15 years, especially in Fresno, Modesto and San Joaquin. It has also been increasing in other pepper-growing regions in the U.S.A and the world.

The virus can cause severe symptoms in various pepper species, e.g., *Capsicum annuum*, *C. chinense* and *C. frutescens*. It is rapidly spread by at least 10 species of thrips, especially the western flower thrips, *Frankliniella occidentalis* in California. This brochure provides an update on TSWV and thrips in pepper in California, and an integrated pest management (IPM) approach.

## SYMPTOMS

Symptoms of TSWV are extremely variable and depend upon the cultivar, the strain of the virus, the time of infection and the environmental conditions.

Pepper plants infected at a young age or as transplants are typically severely stunted and distorted, and generally produce no fruits. Leaves of plants infected at older ages show a wide range of symptoms, including mosaic/mottle, chlorotic flecking, chlorosis-necrosis, crumpling and deformation. In some cases, systemic necrosis of terminal leaves develop followed by new growth with severe mosaic and distortion.

Fruits of infected plants show a wide range of symptoms, including chlorosis, necrosis, spotting, mosaic/mottle, ring patterns and distortion.

In some cases, TSWV-infected plants may show recovery and symptoms will go away.



Close-up of crumpling and mottle/mosaic on a leaf



Symptoms of chlorosis, mosaic/mottle and leaf deformation



Necrosis symptoms on leaves



Symptoms of mosaic/mottle and crumpling

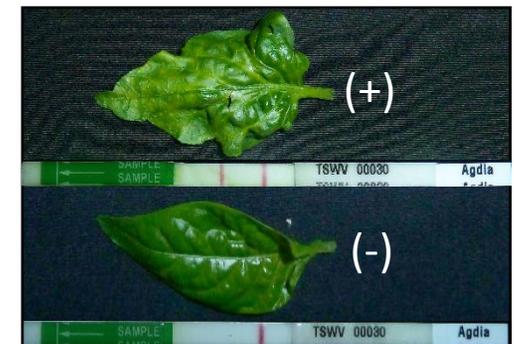


Typical chlorotic ringspots on TSWV infected red chili pepper (A) and sweet-pepper fruit (B)

## DETECTION

Symptoms of TSWV in pepper can be highly variable, and depend on the cultivar and the stage of growth at which plants were infected, and the growing conditions of the crop. Peppers infected with TSWV show some combination of chlorosis and necrosis and distorted growth. In some cases, TSWV can cause defoliation. However, these symptoms can be confused with those of other virus diseases, e.g., *Alfalfa mosaic virus* and *Beet curly top virus* (early in the season).

Thus, it is important that growers and others confirm suspected TSWV infections. Growers can provide samples to their county farm advisor, or use the diagnostic immunostrip (dipsticks) placed in bags containing leaf sap. With this test, results are typically obtained within 5-15 min; a positive result has two lines, whereas a negative test has one line. This test can be purchased from AgDia ([www.agdia.com](http://www.agdia.com)). Additional tests also can be used, e.g., ELISA and RT-PCR/sequencing.



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

## HOST RANGE AND SPREAD

TSWV is a tospovirus (genus *Orthotospovirus*) in the family *Tospoviridae*. The virus is not transmitted via seed, and is spread from plant-to-plant by various species of thrips. The major thrips vector of TSWV in California is the western flower thrips (*F. occidentalis*). Thrips are small and thin insects about (1 to 2 mm) that feed from the phloem of plants.



*F. occidentalis*



Stages of growth of *F. occidentalis*

The virus can only be acquired by immature thrips (larvae). Once acquired, adults thrips can transmit TSWV for the remainder of their life (30-45 days). Thrips do not pass the virus to their progeny.

Although TSWV has a very wide host range, up to 1000 plant species, only TSWV-susceptible plants on which thrips can complete their entire life cycle play an important role in the disease cycle. In California, economically important crops include peppers, tomatoes, lettuce, potatoes, and radicchio; along with important ornamental crops like impatiens and petunia. Weeds play an important role in the epidemiology of TSWV, including prickly lettuce (*Lactuca serriola*), black nightshade (*Solanum nigrum*), sowthistle (*Sonchus oleraceus*), and cheeseweed (*Malva parviflora*).

## AN IPM STRATEGY FOR MANAGEMENT OF TSWV OF PEPPERS IN CALIFORNIA

Effective management of TSWV in pepper in California requires an integrated pest management (IPM) approach that targets the thrips vector and TSWV. This strategy can be divided into three parts:

### I. Before the growing season

- Prevent initial infection by planting TSWV-resistant pepper cultivars with the *Tsw* gene. A problem with this strategy is the emergence, in different regions of the world (e.g., Italy and Spain), of TSWV strains that overcome (break) the *Tsw* gene.

- Use virus- and thrips-free pepper transplants (from greenhouses that monitor and treat when necessary).
- Pepper seeds do not transmit TSWV.
- If thrips are present on transplants, be sure to manage populations with insecticides prior to planting in the field.

### II. During the growing season

- Avoid planting new fields near old fields (especially susceptible cultivars with confirmed TSWV infection).
- Promote a healthy vigorous crop and avoid stress. Practice good fertility and water management.
- Monitor and manage thrips populations with yellow sticky cards or modeling (e.g., degree days).
- Manage thrips with insecticides, when numbers increase and TSWV is present. Be sure to rotate chemicals to minimize the development of resistance.
- Straw mulching may alleviate plant stress and reduce susceptibility to thrips.
- Manage populations of weeds in or around fields.

### III. After the growing season

- After harvest, promptly remove and destroy old pepper plants.
- Control weeds in fallow fields or unused land near future pepper fields.
- Utilize regional management of all fields after harvest, before late-fall or early winter.

Some Insecticides for Thrips Management	
Trade name (common name)	Resistance Management class
Radiant (spinetoram)	5
Success (spinosad)	5
Lannate (methomyl)	1A
Beleaf (flonicamid)	9C
Pounce (permethrin)	3

(Note: read and follow label directions, and consult the label before purchase to determine the class of insecticide)

**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 email: [rlgilbertson@ucdavis.edu](mailto:rlgilbertson@ucdavis.edu))

# TOMATO SPOTTED WILT DISEASE IN PEPPER

## *Detection, Epidemiology and Integrated Pest Management (IPM)*



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