



AGRONOMIC SPOTLIGHT



VIRAL DISEASES IN FRESH MARKET TOMATOES

- » Many different viruses cause diseases of tomato that can impact yield and fruit quality.
- » Accurate diagnosis and control of viral diseases of tomato may require testing by a diagnostic lab.
- » Management of viral diseases includes using procedures to prevent or delay infection of the crop.

Viral diseases of tomato typically cause changes in plant growth and pigmentation resulting in symptoms such as yellowing, mosaics (alternating patches of light and dark green or green and yellow), stunting, and malformations (stem twisting, leaf puckering and rolling). Symptoms can be subtle and similar to those caused by nutrient deficiencies and herbicide injury. In many cases, laboratory testing is needed to accurately identify the specific virus causing the disease, as the symptoms of many virus diseases are similar.

CUCUMBER MOSAIC VIRUS

Cucumber mosaic, caused by the *Cucumber mosaic virus* (CMV), occurs in tomato production areas throughout the world, but it is mostly important in temperate growing regions. The most characteristic symptoms of CMV infection is the shoestring distortion of leaves, where the leaf blades do not expand, leading to thin, narrow leaves (Figure 1).¹ Infected plants are somewhat chlorotic (light green to yellow), bushy, and stunted. Leaves can also show mosaic symptoms, which may develop on the top (young) and bottom (older) leaves, while the middle leaves appear healthy.^{2,3} The fruit produced on CMV infected plants are usually smaller than normal, and they may appear mottled and/or have brown patches.¹ There are several different strains of CMV that produce somewhat different symptoms.



Figure 1. Shoestring leaf distortion symptoms of *Cucumber mosaic virus* (CMV) infection of tomato.

CMV has a very wide host range. It is able to infect over 1,200 species of plants, including many weed and vegetable crop species, all of which can serve as sources of infection.¹ The virus is spread (transmitted) by several species of aphids. The aphids can pick up the virus within a few minutes of starting to feed on an infected plant, and transmit the virus to a healthy plant just as quickly. However, the aphids are only able to transmit the virus for a short time, and they become non-infectious after a few minutes of feeding or probing. The pathogen spreads most rapidly when large populations of aphids are moving through a field rather than colonizing the crop.² CMV is not seedborne and not easily spread by workers or equipment.⁴

There are no commercial tomato cultivars with resistance to CMV, so management strategies focus mostly on preventing or delaying infection by restricting the movement of virus infected aphids into the planting.¹ Growers should avoid growing tomato transplants near ornamental or bedding plants.³ Silver, reflective mulches can repel aphids delaying infection, early in the season until foliage covers the mulch.² Also, surrounding a tomato crop with several rows of a taller, non-host crop, such as corn, can act as a trap crop for aphids.^{1,3} Eliminating weed hosts in and around the field can also slow the spread of the virus into the crop.

POTATO VIRUS Y

Potato virus Y (PVY) is found worldwide, but unlike CMV, the host range of PVY is limited mostly to solanaceous plants, including tomato.¹ Symptoms of infection vary with the strain of PVY, the cultivar of tomato, the age of the plant, and environmental conditions. Infected plants are usually lighter in color and have a bushy appearance.² Mosaic patterns develop on the leaves, most obviously on young leaves. Dark bands can develop along the veins, and dark-brown, necrotic areas can form on the leaflets.¹ Terminal leaflets may die. If plants have been infected for a long time, leaflets may show a downward rolling symptom. Fruit on infected plants may be distorted with mosaic coloring, uneven ripening, and internal browning.²

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There are several strains of PVY, and the virus can be transmitted by several species of aphids. The virus can also be spread by infected sap on workers and equipment. As with CMV, aphids pick-up and deposit PVY quickly, but they do not remain infective for very long. Several solanaceous weeds (e.g., black nightshade and ground cherry), as well as other crop species (potato and pepper) can serve as sources of inoculum of the pathogen. Overlapping tomato and pepper crops in areas such as Florida, allow virus inoculum levels to become very high.^{1,2}

As with CMV, the focus of management strategies for PVY is to prevent or delay infection. Isolation from older plantings of tomato and pepper and planting in areas less suitable for aphids will reduce the spread of the virus into a planting. Planting on reflective mulches and spraying plants with mineral oil can also repel the aphids and lower the frequency of virus transmission (infection).^{1,2} Regularly sanitizing tools with 10% bleach can help slow the spread of PVY in greenhouse production systems. Some host resistance to PVY is available in cultivars that contain the *pot-1* resistance gene.

TOBACCO MOSAIC VIRUS AND TOMATO MOSAIC VIRUS

Tobacco mosaic virus (TMV) and *Tomato mosaic virus* (ToMV) are closely related viruses that can cause significant losses in both field and greenhouse tomato production systems.^{1,4} ToMV is more commonly found on tomato than is TMV. Symptoms of infection can vary with the strain of the virus, tomato cultivar, state of plant development at the time of infection, and the light and temperature conditions. Characteristic symptoms include light and dark green mottled areas on the leaves (Figure 2a). These symptoms can be masked when temperatures are high, but necrotic (dead tissue) symptoms can develop at high temperatures on some cultivars. If infected early, plants can be stunted and somewhat chlorotic. Leaves on infected plants can be curled and malformed, but not usually to the degree of severity seen with CMV infection. Fruit on infected plants show uneven ripening (Figure 2b) and are usually smaller than fruit on healthy plants. With some virus strains the fruit can develop internal browning or brown wall symptoms.^{1,3}

Unlike most plant viruses, TMV and ToMV are not transmitted by insects to any great extent.⁴ These viruses are transmitted from plant to plant through human activities including the handling of transplants, tying, pruning, suckering, and harvesting. These viruses are very stable, and infective virus particles can be found on seed and in leaf- and root-debris. Infective virus particles can even be found in tobacco products and be transmitted by workers.^{1,2}

Workers should wash their hands with soap and water before and after working with tomato plants. Certified disease-free seed should be used.³ Alternatively, seed can be treated with 10% trisodium phosphate (for 15 minutes), or dry seed can be heat treated at 158°F (70°C) for two to four days. Avoid planting where tomato root debris is present and in sites with solanaceous weeds and volunteer tomato plants.¹ There are at least three genes that provide resistance to TMV and ToMV (*Tm-1*, *Tm-2*, *Tm-2²*). *Tm-2²* is commonly used in commercial tomato cultivars. However, strains of ToMV that can overcome this form of resistance have been detected in some areas.

If feasible, infected plants should be removed (rogued-out) as soon as they are detected to prevent further spread. Crop debris should be incorporated into the soil quickly after the final harvest to promote decomposition, and equipment should be cleaned between use in diseased and healthy plantings.

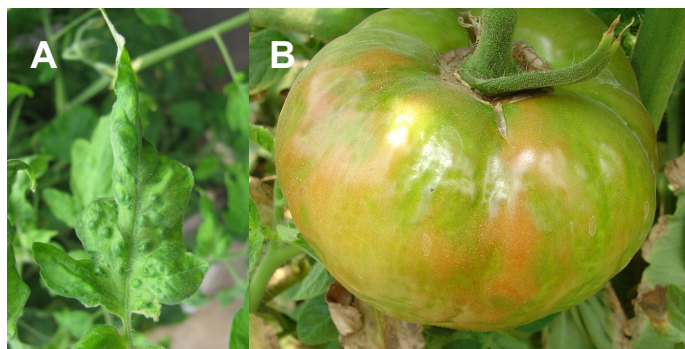


Figure 2. ToMV symptoms: (A) foliar mosaic symptoms and (B) mild deformation and uneven ripening of fruit.

Sources:

- ¹ Jones, J., Zitter, T., Momol, T., and Miller, S. 2014. Compendium of tomato diseases and pests, second edition. American Phytopathological Society, St. Paul, MN.
- ² Davis, R., Miyao, G., Subbaro, K., Stapleton, J., Aegerter, B. 2013. UC IPM pest management guidelines: Tomato. UC ANR Publication 3470.
- ³ Reiners, S., Bellinder, R., Curtis, P., Helms, M., Landers, A., McGrath, M., Nault, B., and Seaman, A. 2017. Cornell integrated crop and pest management guidelines for commercial vegetable production.
- ⁴ Zitter, T. and Provvidenti, R. 1984. Virus diseases and disorders of tomato. Cornell University, Cooperative Extension, Vegetable MD Online, Fact Sheet Page: 735.40.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology Development & Agronomy by Monsanto.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about viral diseases of tomato. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with this specific crop.

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