

Leaf distortion, Mottling, and TSWV in Greenhouse Tomatoes



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Curling, distortion, necrotic patches, mottling, and small ringspot-like symptoms were seen on leaves of greenhouse tomatoes. These kinds of symptoms are most often attributed to virus infections, and rightly so. There are numerous viruses that infect tomatoes. This alert highlights the need for testing samples for possible viruses rather than guessing or jumping to conclusions.

Earlier this spring, a greenhouse with a history of past virus infection on their tomatoes started seeing curling leaves and off-color foliage with purple and yellowish patches on their young plants (Figure 3). Plant samples were submitted to the University of Wyoming Extension Plant Diagnostic Laboratory to check for possible virus infection. Last summer, similar looking plants (Figure 1) were submitted, and after testing for several viruses, the plants were confirmed to have tomato spotted wilt virus (TSWV). Fruit from the plants also tested positive for TSWV (Figure 2). The leaf curling and distortion observed on these plants was not typical of TSWV infection, which most often causes black to purplish leaf spotting and discoloration along leaf veins and petioles on tomato (Figure 6). Tan leaf spotting and terminal dieback are symptoms on pepper (Fig. 7).



Figure 1: Curling and distortion of terminal shoots and some discoloration of tomato leaves infected with TSWV. (Image by J. Williams-Woodward)

Originally, the assumption was that the leaf distortion, if not due to virus infection, could be due to herbicide injury. However, the diagnostic lab cannot test for herbicide residue nor were herbicides used according to the grower. Leaf curling on the terminal shoots can also be caused by warm daytime and cold nighttime temperature fluctuations, which often occurs in the Mountain West of the USA. Mites, eriophyid mites, and aphids can cause leaf curling as well. No insects or mites were seen on the samples. No other fungal or bacterial pathogen was recovered from the necrotic spotting, and it was determined that the leaf spotting was most likely due to nutrient deficiencies such as magnesium (often because of excess potassium) that often causes yellow to brown patches between the leaf veins.

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The final diagnosis of the sample was that TSWV was the likely cause of the fruit and foliage symptoms, but that temperature fluctuations and nutrient deficiencies contributed as well.

TSWV is spread by thrips, most often western flower thrips, in a persistent manner. The virus is acquired by the juveniles from the roots of the infected plants. The virus remains in the thrips through molting and is spread by adults moving within the greenhouse. Virus control recommendations included controlling and monitoring thrips populations, removal of all infected plants, and the grower also removed all rooting medium where infected plants were grown that year. The greenhouse was sanitized and replanted after several months of being empty using new containers and rooting medium to reduce carrying over thrips and the virus into their crop this year. New seed was also purchased as a precaution because the infected tomato cultivar, 'Hot Streak', is listed as resistant to TSWV.

When young plants started showing similar symptoms of leaf curling, distortion, and mottling this spring, there was concern again about possible virus infection. Samples were brought to the diagnostic lab and were tested for multiple viruses including tomato spotted wilt (TSWV), tobacco mosaic virus (TMV), tomato mosaic virus (ToMV), and cucumber mosaic virus (CMV) as these viruses often cause leaf curling, plant stunting and foliage mottling. All virus tests were negative, and the curling of the terminal shoots was likely due to temperature fluctuations. Many of the issues subsided until older leaves started showing light-colored mottling tiny ringspot-like symptoms (Figures 4 and 5). To rule out a biotic cause the tomato tissues were tested for a barrage of viruses including Pepino mosaic (PepMV), Alfalfa mosaic (AMV), Tobacco ringspot (TRSV), Tomato mottle mosaic (ToMMV), Tomato ringspot (ToRsv), Capsicum chlorosis (CaCV), Potato virus Y (PVY), Potato virus X (PVX), Impatiens necrotic spot (INSV), Potyvirus group (POTY), Tomato brown rugose (ToBRFV), in addition to TSWV, CMV, TMV, and ToMV. All tests were negative for virus infection. The grower is keeping an eye on the plants and making sure they are getting adequate irrigation and fertilizer, which is a lot less costly and time-consuming than the initial reaction of wanting to discard all plants and start over.

Viruses are a major concern within greenhouse tomatoes; however, diagnostic testing can help determine if symptoms are truly due to a virus.



Figure 2: Tomato fruit showing bronzing, distortion, necrotic spotting, and some ringspots due to TSWV infection. The variety is 'Hot Streak', a hybrid with TSWV resistance. (Image by J. Williams-Woodward)



Figure 3: Leaf curling and distortion of terminal shoots on young tomato plants. These plants tested negative for multiple viruses. The cause of the symptoms is likely temperature fluctuations within the greenhouse. (Image by J. Williams-Woodward)



Figure 4: Light-colored mottling and tiny ringspot-like symptoms on older tomato leaves. These plants tested negative for 15 viruses common on tomato. The cause of the spotting is likely abiotic. (Image by J. Williams-Woodward)

Below are common tomato viruses and their symptoms. If you are seeing symptoms, get your plants tested at a university, state, or private diagnostic lab to help reduce virus spread:

Tobacco mosaic (TMV) – Symptoms are like ToMV. Mosaic patterns of lighter green and/or brown streaking on leaves, leaf distortion and curling possible; fruit set is uneven and fruits may develop a brown patchy appearance.

Tomato mosaic (ToMV) – Symptoms are like TMV. Yellow and green mottling, curling, reduce size, and malformation of leaves; fruit ripen unevenly and may have faint yellow ringspots.

Cucumber mosaic (CMV) – Stunting, some leaf mottling, leaf twisting and shoestring-like leaf distortion; new leaves may be deformed and roll; fruit may fail to mature.

Alfalfa mosaic (AMV) – yellowing and bronzing of terminal shoots, and necrosis of leaf veins; leaflets curl downward; necrotic spots and distortion of fruits.

Pepino mosaic (PepMV) – Yellow mosaic and spots that become bright yellow as the leaf ages, severe leaf distortion, may cause necrotic lesions on stems and petioles. Uneven fruit ripening and marbling are common.

Tomato spotted wilt (TSWV) – Symptoms vary; leaves can bronze, develop small dark spotting, curl downward, and wilt; dark spots and streaks can develop on petioles and stems; plants may wilt; fruits develop chlorotic or concentric ring spots.

Tomato mottle mosaic (ToMMV) – Necrotic leaf lesions, leaf chlorosis and distortion common; fruit necrosis is common.

Potato Virus Y (PVY) – Faint mottling and leaf distortion, yellowing along veins, petioles curve downward, purple streaking on stems

Tobacco and tomato ringspot (TRSV) – ringspot or zigzag lines on foliage, petioles and fruits

Tomato brown rugose fruit virus (ToBRFV) – Seedborne; federally regulated virus with restriction on importing seed and propagative material from countries where virus is present. Symptoms are yellowing, bubbling, mosaic and mottling, fern leaf and leaf narrowing are seen mostly on the upper leaves; fruit may have a rough surface and blotchy, pale, or yellow-brown spots similar to other viruses.



Figure 5: Light-colored, tiny ringspot-like symptoms and distortion on older tomato leaves. These plants tested negative for 15 viruses common on tomato. The cause of the spotting is likely abiotic. (Image by J. Williams-Woodward)



Figure 6: Purplish spotting and distortion of tomato leaflet and discoloration along the petioles due to TSWV infection. (Image by J. Williams-Woodward)



Figure 7: Tan necrotic leaf spots, ringspots, black to purple streaking along petioles, and terminal dieback on bell pepper due to TSWV infection. (Image by J. Williams-Woodward)

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