

VEGETABLE CROPS

Virus Diseases and Disorders of Tomato

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Tomato is one of the most widely grown vegetable crops, its planting area ranging from small backyard plots, to much larger field acreages, to more-specialized greenhouse trellis operations. Virus diseases, in general, are not a routine problem in most tomato plantings because growers are usually aware of the precautions necessary to reduce their incidence.

On the basis of frequency of occurrence, tomato virus diseases and disorders can be separated into two groups: those spread by humans and those spread by insects.

Major Tomato Viruses

Tobacco mosaic virus (TMV) is distributed worldwide and may cause sig-

nificant losses in the field and greenhouse. TMV is one of the most stable viruses known, able to survive in dried plant debris as long as 100 years. Many strains of TMV have been reported and characterized. TMV can be seedborne in tomato, is readily transmitted mechanically by human activities, and may be present in tobacco products. The virus is not spread by insects commonly occurring in the greenhouse or field.

The symptoms in tomato vary greatly in intensity depending upon the variety, virus strain, time of infection, light intensity, and temperature. High temperatures, for example, may mask foliar symptoms. The most characteristic symptom of the disease on leaves is a light- and dark-green mosaic pattern (fig. 1). Some strains (referred to as the acuba strains) may cause a striking yellow mosaic, whereas other strains may cause leaf malformation and "fern-leaving," suggestive of cucumber mosaic virus infection. With the use of TMV-resistant or -tolerant varieties, plants may be infected by some strains whose symptoms are latent. Ordinarily the fruit from infected plants do not show mosaic symptoms, but may be reduced in size and number. At times, fruit may develop a "brown wall" or "internal browning" defect. This disorder is particularly evident in well-developed but

unripe fruits of the first cluster, involving a collapse of cells in the fleshy parenchyma. The cause is attributed to a "shock reaction" following TMV infection, with a number of other factors contributing to the severity of symptoms (high soil moisture, low nitrogen and boron, and sensitivity of the variety).

Because of the persistent nature of TMV, special care must be taken to exclude the introduction of the virus and to prevent recontamination. Seeds suspected of carrying TMV should be treated with a 10% solution of trisodium phosphate (Na_3PO_4) for 15 minutes, rinsed in running tap water, dried, and treated with a seed fungicide. Control of TMV spread in the greenhouse is especially difficult because plants are handled more often than in the field. Hygienic measures must be taken to prevent the introduction and spread of this virus. Choose only varieties resistant to TMV and rogue any suspicious plants as soon as they are observed.

Single and double virus streak and tomato leaf rolling are three separate diseases, which involve strains of TMV, mixed infections of TMV with other viruses, or interaction of TMV with a specific tomato gene. *Single streak virus* is caused by a strain of TMV that causes the same foliar symptoms as other TMV strains, but under certain



environmental conditions the plant develops brown streaks on the stems and petioles. On the fruit the symptoms appear as slightly sunken brown rings (fig. 2) *Double virus streak* is the result of a mixed infection of TMY with potato virus X (PVX). Both viruses are readily transmitted mechanically and, when they occur together, result in brown streaks along the petioles and stems, and small, irregular brown areas on fruits. *Leaf rolling* is the result of TMY infection interacting with the wilty gene (wt) found in some tomato varieties. Individual leaflets are tightly curled adaxially (inwardly), which is an undesirable condition.

Cucumber mosaic virus (CMV) is the second most important virus disease of tomato in the state. CMV has an extensive host range and is transmitted by aphids in a nonpersistent manner. Unlike TMY, CMV is not seedborne in tomato and does not persist in plant debris in the soil or on workers' hands. CMV has been found in greenhouse plantings in New York. Seedlings grown outdoors and left unprotected by isolation before moving indoors are one likely source of infection. Other sources of inoculum are the spread of CMV by aphids from infected plants in adjoining greenhouses (weeds under benches, ornamentals, or other vegetables) and by viruliferous aphids entering through non-insect-proof vent windows.

The symptoms of CMV on tomato can be spectacular, with the most characteristic symptom being shoestringlike leaf blades (fig. 3) The symptoms of CMV can be transitory, and bottom leaves or newly developed top leaves

may show a mottle similar to that caused by TMY (fig. 4).

Because of the wide host range for CMV, sources of inoculum for field plantings are numerous. Avoid planting near weedy border areas or isolate tomatoes from such areas by growing taller, nonsusceptible barrier crops such as corn. No CMV-resistant or -tolerant varieties are currently available.

Minor Tomato Viruses and Disorders

Tobacco etch virus (TEV) and potato virus Y (PVY), are two common tomato viruses in some areas of southern United States and in Central America. TEV has been recovered from infected tomatoes in New York; infections with PVY have probably occurred, but have not been reported. The symptoms of TEV and PVY can be confused with TMV. Because some varieties carry partial resistance to TMV and none have been bred for resistance to either TEV or PVY, plants with a general mosaic suggest TEV or PVY infection. TEV symptoms are usually more severe (fig. 5), causing foliage distortion and severely stunted plants.

Because of the lack of virus resistance and because both viruses are transmitted by aphids in a nonpersistent manner, most control measures are developed around the removal of solanaceous weed reservoirs. In southern states where tomato viruses are particularly troublesome, commercial growers have successfully used mineral oil sprays to delay virus spread in their crops.

Potato leafroll virus (PLRV) is more

commonly associated with potato, but a tomato-specialized isolate of PLRV has been identified in New York and Florida. Leaf rolling and marginal leaf chlorosis are the typical foliar symptoms seen with this virus (fig. 6). Because this virus is transmitted by aphids in a persistent manner, aphid control should reduce the amount of virus spread.

Tomato spotted wilt virus (TSWV) can cause a severe disease of tomato, especially in tropical areas like Hawaii where thrips are plentiful. In addition to causing foliar necrosis and brown streaking of the stems and petioles, fruit are severely mottled, making them unmarketable (fig. 7).

TSWV occurs sporadically in New York. Use of insecticides to control the vector reduces disease incidence.

Tomato big-bud mycoplasma (TBB) is a disorder of tomato more closely identified with subtropical areas of the world where this disease with the leafhopper as vector is more commonly found. Because of the migratory nature of insects such as leafhoppers, TBB has previously been reported from New York.

As the name implies, the buds' size is greatly accentuated by this mycoplasma-like organism (fig. 8), rendering the plant incapable of setting normal fruit. Leafhoppers are generally not difficult to control in temperate climates; thus, vector control should reduce the incidence of this disease.

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