



AGRONOMIC SPOTLIGHT



TOMATO NECROTIC STREAK VIRUS

- » Tomato necrotic streak virus was first discovered on tomatoes growing in Florida in 2013.
- » Infection by this virus results in the development of necrotic streaks along the veins of tomato leaves.
- » The virus can be transmitted at a low level via seed, but under field conditions, it is believed to be transmitted by infected pollen, likely in association with insect vectors.

Many different viruses infect tomato, and the resulting diseases can cause significant economic losses. Most viral diseases of tomato cause mosaic or yellowing symptoms of the leaves, discoloration of the fruit, stunting of plants, and/or distortions of growth. In 2013, a previously unknown virus was detected on tomato plants growing in the Palm Beach and Miami-Dade County areas of Florida. The virus was given the name Tomato necrotic streak virus, and the disease it causes is called tomato necrotic streak.¹

TOMATO NECROTIC STREAK VIRUS (TomNSV)

Tomato necrotic streak virus (TomNSV) was discovered when tomato plants in southeastern Florida showing virus-like symptoms were tested for the presence of known tomato viruses. All of these tests were negative, indicating that the observed symptoms were caused by a previously unidentified pathogen.² Further investigation revealed the presence of a previously unknown species of Ilarvirus.

TomNSV was detected again on tomato plants from the same or nearby fields in southeastern Florida in 2014 and 2015. After the cause of the disease was identified, other crop and weed species in the same fields and surrounding areas were tested for the presence of the virus, but no other plant species were found to be infected by TomNSV in these areas.¹



Figure 1. Foliar symptoms on tomato leaves infected with Tomato necrotic streak virus. Necrotic streaks develop along the leaf veins. Scott Adkins, USDA-ARS.

SYMPTOMS AND HOST RANGE

Symptoms of TomNSV infection of tomato are somewhat similar to symptoms caused by Tomato chlorotic spot virus (TCSV) and Groundnut ringspot virus (GRSV). Infected leaves develop necrotic or brown streaks along the veins (Figure 1). Flowers that are on the plant at the time of infection usually abort, and any flowers that form after the plant has been infected produce small fruit that show no other symptoms. Fruit that are developing on the plant at the time of infection can develop zippering symptoms (Figure 2).¹



Figure 2. Zippering symptoms on (A) immature green and (B) mature red fruit infected with Tomato necrotic streak virus. Scott Adkins, USDA-ARS.

With the use of inoculation tests, TomNSV was shown to be able to infect tomatoes and tobacco, both belonging to the plant family Solanaceae, but other members of this family, including peppers and jimsonweed, were not susceptible to TomNSV. So far, the only other plant found to be a host of this virus is lambsquarters (*Chenopodium album*), a member of the plant family Chenopodiaceae.

RELATED VIRUSES

Genetic analysis shows that TomNSV is a species of Ilarvirus. Other Ilarvirus species that have been found to be pathogenic on tomato include Tobacco streak virus (TSV), Parietaria mottle virus (PMoV), and Tomato necrotic spot virus (ToNSV). TSV has been known to be a pathogen of tomato for many years, but the pathogen is considered to be a minor problem on tomato.³ PMoV was first isolated from the plant *Parietaria officinalis*, a member of the nettle plant family, and this virus was identified as a pathogen of tomato in Italy in 1998.^{1,4} The Tomato necrotic spot virus (ToNSV) is also a recently discovered virus. It was first isolated from symptomatic tomato plants in California in 2009. Like the Tomato necrotic streak virus, the

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Tomato necrotic spot virus can also infect tobacco and a few species of *Chenopodium*.⁵

TRANSMISSION OF TomNSV

Studies have shown that TomNSV can be transmitted from virus infected to healthy tomato plants in infected sap, a process known as mechanical transmission. The virus also can be transmitted when part of a TomNSV infected tomato plant is grafted onto a healthy plant.¹ The TomNSV pathogen also can be transmitted in infected tomato seed, but initial studies have found that the rate of seed transmission is fairly low (only 0.33%). However, even this low level of seed transmission could be enough to initiate an epidemic in a field of tomatoes. In the study, plants grown from infected seed were stunted and had severely distorted leaves (Figure 3). The initial flowers produced on these plants aborted, but later developing flowers produced small fruit.



Figure 3. Healthy (left) and Tomato necrotic streak virus (right) tomato plants. The infected plant, which was grown from an infected seed, is stunted and has severely distorted leaves. Scott Adkins, USDA-ARS.

The related Tobacco streak virus is also seed transmitted.⁶ Studies with TSV have shown a seed transmission rate of about 10% when either the male or female plant parents were infected with the virus. Seeds coming from a female plant infected with TSV had a lower rate of germination than did non-infected seed or seed that was infected from the male parent (through infected pollen). Seed transmission has also been observed with PMoV.⁷

The primary mode of transmission of TomNSV to plants in the field has yet to be determined. However, based on the mode of transmission of related viruses, it is likely that TomNSV is transmitted through a combination of virus-infected pollen and feeding by insects, such as thrips. Studies on the transmission of the Tobacco streak virus have shown that infection occurs when thrips feed on healthy plants in

the presence of TSV-infected pollen.⁸ No infection occurred when TSV infected pollen was placed on healthy plants in the absence of thrips feeding. Also, no infection occurred when thrips fed on healthy plants in the absence of virus-infected pollen, even if the thrips were allowed to feed on TSV infected plants before feeding on the healthy plants. Researchers speculate that the wounds created by the feeding thrips allow the infected pollen to come into contact with internal plant cells, and the virus can move from the pollen into these cells where infection occurs.

A similar mode of transmission is suspected for the related *Parietaria* mottle virus. In this case, infection by PMoV occurs when insects, including species of thrips, aphids, and whiteflies, feed on plants in the presence of PMoV infected pollen.⁷ It is likely that future studies will show that the transmission of Tomato necrotic streak virus results from a combination of insect feeding and the presence of TomNV infected pollen.

Tomato necrotic streak virus was discovered just a few years ago, in 2013. There is a lot about this pathogen and the disease it causes that is still unknown, including the sources of virus inoculum and reservoir hosts, the modes of transmission and spread, differences in susceptibility of tomato varieties, and effective methods of control. It is also not clear if this virus will be a minor pathogen on tomato or if it has the potential to cause significant epidemics and economic losses. With time and additional research, that information will become known.

Sources:

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- ³ Zitter, T. 2014. Minor virus diseases. In *Compendium of Tomato Diseases and Pests*, Second Edition, Jones, B., Zitter, T., Momol, T., and Miller, S. The American Phytopathological Society, St. Paul.
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- ⁵ Batuman, O., Miyao, G., Kuo, Y. W., Chen, L. F., Davis, R. M., and Gilbertson, R. L. 2009. An outbreak of a necrosis disease of tomato in California in 2008 was caused by a new llarvirus species related to *Parietaria* mottle virus. *Plant Disease* 93:546-547.
- ⁶ Sdoodee, R. and Teakle, D. 1988. Seed and pollen transmission of tobacco streak virus in tomato (*Lycopersicon-esculentum* cv *grosse lisse*). *Australian Journal of Agricultural Research* 39:469-474.
- ⁷ Aramburu, J., Galipienso, L., Aparicio, F., Soler, S., and Lopez, C. 2010. mode of transmission of *Parietaria* mottle virus. *Journal of Plant Pathology* 92:679-684.
- ⁸ Sdoodee, R. and Teakle, D. 1987. Transmission of tobacco streak virus by *Thrips tabaci* a new method of plant virus transmission. *Plant Pathology* 36:377-380.

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. 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 tomato production. 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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180118124815 Published 06-18-2018