



# Managing Tobamoviruses in Greenhouse Production

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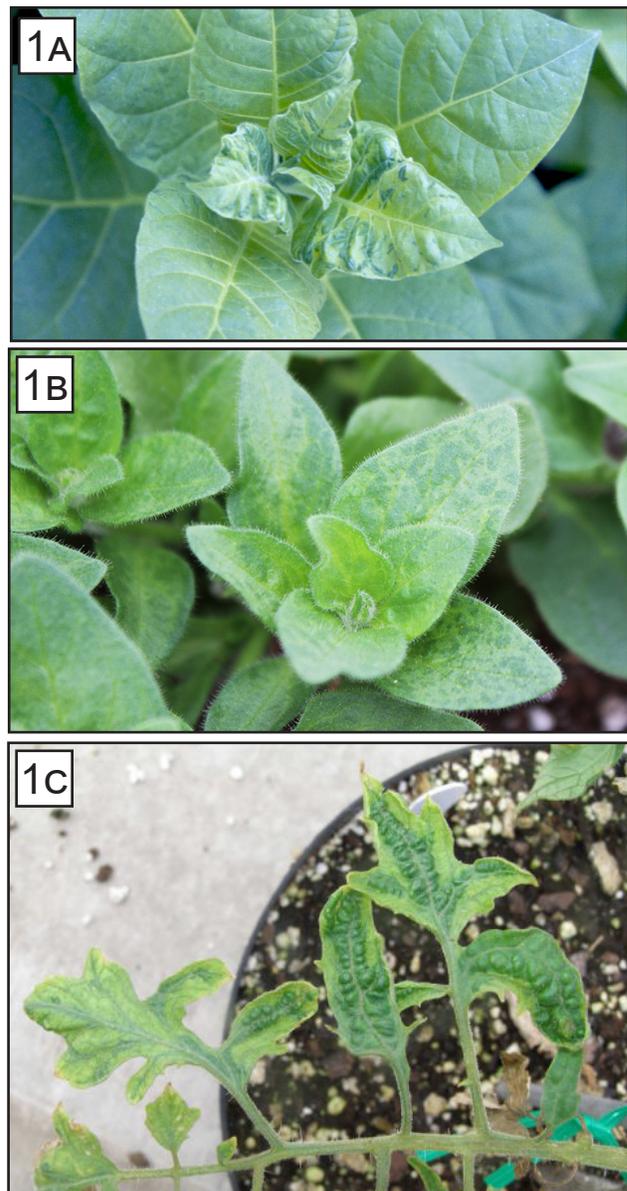
## IMPORTANCE

Tobamoviruses, including tobacco mosaic virus (TMV) and the new tomato brown rugose fruit virus (ToBRFV), can be persistent in greenhouses and other protected cropping environments. Herbaceous ornamentals, vegetables, and tobacco can be affected by tobamoviruses. Once introduced into a site, these viruses can spread rapidly, reducing plant quality and yields. Prevention and careful sanitation are important to maintaining a virus-free production environment for current and future crops.

## SYMPTOMS

Tobamoviruses induce a range of symptoms. These can include mosaic (varying patterns of normal, light green, and yellow; FIGURE 1A), mottling (irregular patterns of light and dark areas; Figure 1B), stunting, reduced blossom production, and poor fruit set. Leaves may appear distorted with wavy borders or puckered regions (FIGURE 1C). Yellowing is common, and under high light conditions, yellowed areas can become bleached. Vein yellowing (chlorosis; FIGURE 2), followed by necrosis (browning) that originates from the petiole, can be characteristic of tobamoviruses. Ringspots and mottle on both mature and immature fruit can occur (FIGURE 3).

Like many viral diseases, symptoms concentrate in newly formed leaves, fruit, and blossoms; virus particles migrate to areas where plants are growing rapidly and then accumulate in these tissues. Viral diseases rarely kill plants; however, yield and quality can be significantly reduced.



**FIGURE 1.** TOBACCO MOSAIC VIRUS (TMV) CAN CAUSE A VARIETY OF SYMPTOMS ON A WIDE RANGE OF HOSTS. ON YOUNG TOBACCO, LEAVES MAY INITIALLY SHOW MOSAIC SYMPTOMS WITH DISTINCT AREAS OF GREEN AND YELLOW (A); ON PETUNIA, LEAVES CAN SHOW MOTTLING PATTERNS WITH SUBTLE SHADES OF LIGHT AND DARK (B); AND ON GREENHOUSE TOMATO, PUCKERING ALONG WITH MOSAIC PATTERNS AND YELLOWING IS COMMON (C).



**FIGURE 2.** TURNIP VEIN CLEARING VIRUS (TVCV) SYMPTOMS ON PETUNIA INCLUDE YELLOW STREAKS ALONG VEINS THAT ORIGINATE AT PETIOLES.



**FIGURE 3.** TOMATO BROWN RUGOSE FRUIT VIRUS (ToBRFV) DAMAGE TO TOMATO FRUIT CAN INCLUDE MOSAIC COLORATION, DISTORTION, AND NECROSIS.

## CAUSES & DISEASE DEVELOPMENT

The most common tobamoviruses are tobacco mosaic virus (TMV), cucumber green mottle mosaic virus (CGMMV), turnip vein clearing virus (TVCV), and tomato mosaic virus (ToMV). They can affect a wide range of herbaceous ornamentals (e.g. petunia and verbena), vegetables (e.g. tomato and cucumber), weeds (e.g. amaranth and nettle), and tobacco. A new virus, tomato brown rugose fruit virus (ToBRFV), can infect tomatoes, peppers, tobacco, and petunia.

Initial introduction of tobamoviruses may occur via seed, contaminated planting material, plant debris, or through infested surfaces, such as gardening/farming tools and equipment. The tobacco in cigarettes often tests positive for TMV and may also serve as a source for introduction.

Tobamoviruses are primarily transmitted from plant to plant via mechanical means, particularly when plants are handled by workers. In addition, some virus particles, such as TMV, are extremely persistent in the environment; they can remain infectious for decades on equipment, tools, greenhouse benches, tobacco stakes, and even doorknobs and clothing. Plant debris can also serve as a reservoir for virus particles.

Most viral diseases in commercial plantings begin at very low incidence (5% of plants or fewer). However, because tobamoviruses can be moved on hands or

equipment every time plants are handled or touch one another, they tend to spread easily and quickly. Insect transmission is rare for most tobamoviruses.

Viruses differ from other disease-causing organisms in several ways:

- They are so small they can only be seen with a high-powered microscope.
- They consist of genetic material (RNA, in the case of tobamoviruses) wrapped in a protein coat.
- They require a living host to increase their numbers.
- They hijack their host's cells to replicate, which is why viruses rarely kill their host.

## DISEASE MANAGEMENT

Few chemicals are available to manage tobamovirus diseases, and none are very effective. Thus, the cultural practices identified below are extremely important for managing spread.

### PREVENTION

It is critical to avoid introduction of tobamoviruses into greenhouses and high tunnels.

- Begin with clean plant material and certified seed. Purchase certified disease-free seed or seed from areas where the viruses are not yet found. If purchasing transplants or plugs, do not accept any plants with visible virus symptoms.
- Separate new or high risk plant material from established plantings.

- Keep records of planting material sources, particularly in succession plantings.
- Scout greenhouses and fields, especially if there has been a history of disease. Seed infestation rates for tobamoviruses are 4% or less, so transplant lots should be thoroughly scouted.
- After using tobacco products, wash hands thoroughly to avoid introducing tobamoviruses into crops under production.

## RESISTANCE

Use resistant cultivars when possible; resistance status is denoted in seed catalogs or production guides.

- A number of tomato and pepper cultivars are resistant to TMV and ToMV.
- Many tobacco cultivars are resistant to TMV, but KT-215 and KT-219 notably are not.

## ROGUING

When viral symptoms are recognized in a particular plant, dig the plant (including roots) as gently as possible and bag for removal. Nearby plants should also be removed. Burn or bury these plants far from production areas.

## SANITATION

A strict sanitation program is important to avoid spread.

- After symptomatic plants are removed, wash hands and equipment thoroughly to remove virus particles.
- Pruning tools should be sanitized between plants. Solutions that inactivate tobamovirus particles are 10% bleach, 20% powdered milk solution, and the industrial cleaner trisodium phosphate (TSP). Soak tools for at least one minute to inactivate virus particles; a quick dip will not be effective. Protect your skin and clothing during disinfestation.
- Alcohol-based products and commercial greenhouse cleaners are ineffective against tobamoviruses.

## ADDITIONAL RESOURCES

- Burley and Dark Tobacco Production Guide (UK-160)  
<http://www2.ca.uky.edu/agcomm/pubs/id/id160/id160.pdf>
- Greenhouse Sanitation (PPFS-GH-04)  
<https://plantpathology.ca.uky.edu/files/ppfs-gh-04.pdf>
- Managing Greenhouse & High Tunnel Environments to Reduce Plant Diseases (PPFS-GH-01)  
<https://plantpathology.ca.uky.edu/files/ppfs-gh-01.pdf>
- Vegetable Production Guide for Commercial Growers (ID-36)  
<http://www2.ca.uky.edu/agcomm/pubs/id/id36/id36.pdf>

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