Fact Sheet Project GNE18-176-32231

Tomato spotted wilt orthotospovirus (TSWV) and Impatiens necrotic spot orthotospovirus (INSV)

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Tomato spotted wilt orthotospovirus (TSWV) and Impatiens necrotic spot orthotospovirus (INSV) are orthotospoviruses that can affect a wide array plants including vegetables and ornamentals worldwide. Losses can reach as high as 100%, causing billions of dollars in damage worldwide annually.

The viruses infect both monocots and dicots. Some notable crops include tomato, peanut, tobacco, cucumber, eggplant, and potato. In ornamentals, common garden plants such as chrysanthemum, cyclamen, gerbera, calla lily, African violet, and geranium; as well as perennials such as dahlia, aster, poppy and peony are hosts.

Weeds can also be hosts and act as potential reservoirs for viruses as well as their vectors. In some cases, the weeds can harbor the virus but not show symptoms. Some examples of common weeds that can be infected by at least one of the two viruses are spiny amaranth, verbena, nightshade, and sweet yellow clover.

Symptoms

Symptoms of the two viruses are indistinguishable, and are especially difficult to diagnose in early stages of infection. Symptoms can also vary depending on the virus strain, plant host, and environmental conditions. Characteristic symptoms include concentric rings of lighter color on leaves, flowers and fruits, as well as inward curling of leaves, dark streaks, off-color foliage, wilting of the top portion of the plant, necrosis, and overall stunting. If the plant is able to produce fruit, they develop chlorotic or necrotic patches and do not uniformly ripen, rendering them unmarketable.

Figure 3. Left. TSWV symptoms in pepper. Image Credit: Juan Francisco Iturralde Martinez, Penn State University. Right: WV symptoms in Geranium. Image Credit: :Dr. Backhaus, Biologische Bundesanstalt für Land- und Forstwirtschaft, Bugwood.org.

Figure 4. Left: INSV symptoms in Impatiens. Image Credit. Cristina Rosa, Penn State University. Right: INSV symptoms on Begonia. Image Credit. Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Symptoms alone should not be used for diagnosis since they can resemble those caused by other pathogens and abiotic stresses. Spotted wilt can be diagnosed by commercially available tests or by commercial diagnostic laboratories, as well as university or state affiliated plant disease clinics such as the Penn State Plant Disease Clinic.

Vector

The only way that the viruses can infect and move between plants is through thrips feeding. Thrips are very small elongated insects, of less than 1/25-inch in length, and are usually brown, black, or yellow in color. Due to their size, they are hard to see with the naked eye, allowing them to reside in very small crevices.

Figure 1: Detail of a thrips on a leaf. Image credit: Frank Peairs, Colorado State University, Bugwood.org

Thrips can only acquire the virus if they feed on an infected plant while they are in the larval stage. Once acquired, the thrips will retain and transmit the virus in a circulative-propagative manner for life. The virus is transmitted when the thrips injects contaminated saliva during probing or feeding on target plants. While infected thrips cannot pass on the virus to their young, overlapping generations maintain persistent plant infection. Thrips by themselves can also cause damage by feeding on the contents of plant cells. This leaves unaesthetic silvery specks on the infested tissue, thus reducing photosynthesis as well as creating points of entry for other pathogens and soft rot organisms.

Figure 2: Damage caused by thrips. Image Credit: Whitney Cranshaw, Colorado State University, Bugwood.org

Temperature impacts the reproductive rate of thrips, with a 14-day life cycle under optimal temperatures of 68 to 98 °F. Thrips populations tend to be greatest under hot dry conditions and therefore tend to be most problematic in protected culture systems such as greenhouses and high tunnels. In the field, frequent rain events or overhead irrigation can physically wash the thrips off the plants.

Adult thrips are the most motile and thus the most efficient at spreading the viruses longer distances. However, despite having wings they are not good flyers. Nonetheless, by being so small, they can be carried far by the wind. In the US, movement of virus infected or thrips infested plant material is the primary pathway for spreading both the virus and the vector.

Disease management and prevention

Once a plant is infected nothing can be done to "cure" the plant. Therefore, most management efforts focus on prevention and integrated pest management. Infected and neighboring plants, including weeds, should be discarded to prevent further spread of the virus.

Never grow vegetables and ornamentals in the same greenhouse. Thrips are commonly brought in on transplants and quickly spread throughout the greenhouse.

Before growing season:

- Spraying early might be more effective for controlling thrips than anytime later in the growing season.

- Resistant varieties that contain the sw5 genes can prove useful, however several TSWV isolates have been able to break this resistance. Some parts of California contain these TSWV resistance-breaking isolates.

- Start with virus free material, thoroughly scout planting material and quarantine/separate plants that are suspected to be infected with a virus or infested with thrips. If infested with thrips, treat immediately or discard.

- Seed transmission of the viruses is extremely rare and therefore not a concern. When possible, keep plants grown from seed separated from those produced by vegetative propagation.

During growing season

- Scout individual crops regularly for thrips by gently shaking foliage over a light-colored surface such as a piece of paper or by using yellow or blue sticky cards. Follow fluctuations in population numbers.
- Use indicators:
    - Plants: these plants could show early virus or thrips activity before mass virus infection, and draw any present thrips away from target plants

    - Thrips: look for thrips damage or use yellow or blue sticky cards. Gently shake foliage over light-colored surface.
- Several reports indicate that the use of metallic reflective mulches in open field production can be effective as a countermeasure against thrips. The mulch confuses the thrips and deters them from landing on the target plant. However, reflective mulches can be expensive and complete control of thrips infestations is hard to achieve.
- Prevent thrips from entering the greenhouse by screening vents and other openings.
- Organisms such as predatory thrips, mites and parasitoid wasps can be used for controlling undesirable thrips. Ideally learn what natural enemies thrips have at the desired area.

After growing season:

- Discard infected material

- Remove weeds that invade crops or that grow nearby as the virus can survive inside them and be picked up again for next season, repeating the cycle.

Avoiding resistance development

Since the vectoring insects are so small and take shelter in the plant buds, a single application of a chemical control is usually ineffective. In addition, thrips damage typically only becomes noticeable after they have already left the plants, rendering chemical control ineffective at this point. Multiple applications beginning at first sight of damage increases control effectivity, however thrips can become resistant to chemicals.
Thrips have been documented to develop resistance to insecticides if exposed to them very frequently and if the insecticides are designed against a broad spectrum of insects. Choosing the appropriate chemical treatment can reduce the risk of developing insecticide resistance and the harming of beneficial natural enemies. Ask your extension provider what insecticide or combination of insecticides might be more useful for your specific application and location.
For more information and professional diagnosis, the Penn State University Plant Disease diagnosis clinic can be reached using the Clinic's website.

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References

https://extension.psu.edu/impatiens-necrotic-spot-virus

https://extension.colostate.edu/docs/pubs/garden/02947.pdf

http://ipm.ucanr.edu/PMG/PESTNOTES/pn7429.html

http://ipm.ucanr.edu/PMG/r783102211.html

http://ipm.ucanr.edu/PMG/r604101021.html

http://www.pestnet.org/fact_sheets/western_flower_thrips_183.htm

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