Tomato Spotted Wilt Virus

a. Virus/pathogen name, including accepted acronyms and synonyms
Tomato spotted wilt orthotospovirus, TSWV – Genus *Orthotospovirus,* Family *Tospoviridae*, Order *Bunyavirales* (ICTV online).
Synonyms: *Tomato spotted wilt virus*, *Tomato spotted wilt tospovirus, Pineapple yellow spot virus*

b. Host range, including resistance or tolerance within the crop hosts, alternate hosts

TSWV infects both monocotyledonous and dicotyledonous plants, encompassing more than 1,000 plant species over 80 families. There are several different resistance genes identified in multiple crops (e.g., chrysanthemum, peanut, tobacco, tomato, and pepper) but no fruit crops. However, the emergence of resistance-breaking TSWV isolates indicate that even if there was resistance there may have been limited durability.

c. Symptoms on crop host including varietal differences with images of symptoms when available

The symptoms of TSWV vary depending on the host plant. There is also variability of symptoms within a single host, due to the age of the plant as well as nutritional and environmental factors. Common symptoms include stunting, ringspots on fruit, and necrosis of leaves. There are many different strains of TSWV, and differences in symptoms may also be attributed to them. Symptoms may vary based on the number of strains present in the host, as well as on the presence of other co-infecting viruses. TSWV infections in weeds are often asymptomatic. In blackberry infections appear asymptomatic although only few cultivars have been assayed. TSWV has been reported in about 100 countries on all continents. Due to the extremely wide host range, including weeds, TSWV has caused severe economic losses to various agricultural, vegetable, and ornamental crops and poses major threats to global food security.

e. Means of spread:

TSWV is transmitted in nature by thrips (order *Thysanoptera*, family *Thripidae*). Seven species of *Frankliniella* and two species of *Thrips* are reported to be the vectors of TSWV (*F. bispinosa*, *F. cephalica*, *F. gemina*, *F. fusca*, *F. intonsa*, *F. occidentalis*, *F. schultzei*, *T. setosus*, *T. tabaci*). Among these species, the western flower thrips (WFT), *F. occidentalis*, is the most efficient vector of TSWV and has a worldwide distribution. Additionally, the movement of infected plant material results in TSWV being spread and introduced into a new setting.

f. Recognized diagnostic tests with cited references:

ELISA is a commonly used serological test for TSWV (e.g., Huguenot et al., 1990; Wang and Gonsalves, 1990; Chen et al., 2016; Karavina and Gubba, 2017). Antibody strips are also available for on-site TSWV detection e.g., Agdia ImmunoStrip® or Loewe®Fast Kit. There are numerous assays for molecular detection of TSWV, using RT-PCR in endpoint and real-time settings (e.g., Weekes et al., 1996; Adkins and Rosskopf, 2002; Debreczeni et al., 2011). There are also assays for the identification of resistance-breaking isolates of TSWV using high resolution melting and TaqMan SNP genotyping (di Rienzo et al., 2018).

g. Sampling recommendations for each pathogen including timing and tissue to be sampled

Early detection of thrips is critical because the symptoms of their feeding are often not noticed until the damage has occurred. Small infestations of thrips are also much easier to control. Sampling recommendations vary from crop to crop. In general, blue or yellow sticky cards provide an easy way to detect thrips. Blue sticky cards catch more thrips, but since other insect pests (e.g., whiteflies, aphids, fungus gnats) are less attracted to blue, yellow cards might be a better option for general pest monitoring. Cards should be placed just above the crop canopy. The number of thrips per card should be recorded and graphed weekly to monitor population levels and aid in control decisions. Flowers can be checked for thrips by tapping a blossom over a sheet of paper. Yellow and white flowers seem particularly attractive to thrips. Crops should be inspected weekly for symptoms and affected plants rogued immediately to prevent viruses from spreading to healthy plants. If symptoms are not clear, samples should be submitted for testing. Indicator plants are being used as an early warning system for the presence of infective thrips in certain ornamental crops (e.g., *Petunia hybrida*, *Nicotiana tabacum* and *N. glutinosa*)

h. Management strategies for the pathogen and the vector(s) of the pathogen

TSWV multiplication in the thrips vector makes virus management difficult because, once infected, adult thrips can migrate long distances to new host plants and transmit the virus before they can be controlled. Due to the severity of TSWV and difficulty in preventing thrips transmission with any single control tactic, such as insecticide treatment, the integration of multiple control tactics is recommended as the best approach. Integrated disease management strategies vary depending on the crop. There as examples (e.g. in peanuts) where long-term insecticide applications did not result in reduction of disease incidence. Chemical insecticide resistance are common among WFT populations. Some of the primary control tactics recommended include the use of UV-reflective mulch and insecticide treatment combined with other tactics. Treatments that deter feeding or induce host resistance mechanisms to deter thrips feeding are more commonly used. These include sprays that contain salicylic acid, harpin proteins, or other substances. Numerous biological control agents are available for thrips. In greenhouse settings minute pirate bugs (*Orius insidious* or *Orius laevigatus*) and predatory mites (e.g.,

Amblyseius swirskii, *Neoseiulus cucumeri*s) are commonly used as effective predators.

i. References

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