THE IMPORTANCE OF NON-CROP WEED SPECIES IN THE ESTABLISHMENT AND PERSISTENCE OF TOMATO SPOTTED WILT VIRUS

Russell L. Groves
Assistant Professor
Department of Entomology
University of Wisconsin
Madison, WI 53706

*Tomato spotted wilt virus* (TSWV) and other closely related tospoviruses are serious threats to many agricultural, ornamental, and greenhouse crops. TSWV was first recorded in the southeastern United States during the middle to late 1980’s with the first collections of the western flower thrips, *Frankliniella occidentalis* Pergande, following shortly thereafter. In North Carolina, TSWV was first detected in tobacco and tomato in 1988, although infections occurred at very low levels. During the following six to eight years, TSWV incidence remained low and was widely scattered among fields, suggesting that endemic inoculum sources had not yet become established. By 1997, TSWV had occurred in nearly every North Carolina county with the incidence in some individual fields reaching high levels. Since then, many flue-cured tobacco fields have experienced 30-50% losses and county-wide incidence of infected plants have averaged 10-15% in Duplin, Onslow, and Pender counties. Although areawide levels of infection were lower in 2000, some tomato, pepper, and tobacco fields again experienced 25-50% infected plants.

Worldwide, this virus is transmitted by at least eight thrips species. In eastern and central North Carolina, the primary vector of TSWV is the tobacco thrips, *F. fusca* Hinds, although *F. occidentalis* may be locally important, especially in the western piedmont and mountainous portions of the state. Thrips acquire TSWV by feeding on infected plants as larvae with a subsequent latent period of approximately 3 to 7 days before transmission of the virus to uninfected plants and remain competent vectors for the remainder of their lives. Thus, only those plants that sustain virus infections and serve as suitable reproductive hosts for the vector can be considered important sources for spread of TSWV.

TSWV has an extensive host range including over 900 plant species. Many plants susceptible to TSWV do not support thrips reproduction and are considered a “dead-end” for virus spread. A more complete understanding of the sources of vector reproduction and TSWV infection was warranted to determine which plant species may serve as both reproductive hosts for vectors and the primary inoculum sources for TSWV spread. The current study was conducted to systematically identify, through field collections, wild plant species supporting both vector reproduction and natural TSWV infection in North Carolina.

Throughout our thrips survey, populations of tobacco thrips varied substantially among the plant species and knawel, common chickweed, dandelion, spiny sowthistle, and purple cudweed were the top five plant species supporting *F. fusca* reproduction. Immature *F. fusca* were abundant relative to adult numbers on only a few host species, indicating that not all plant species surveyed supported equal amounts of reproduction. Similarly, populations of plant species varied in abundance both spatially and temporally.
among the survey locations. Some plant species were considered very abundant while others were relatively rare or even absent at other remaining locations. TSWV infection was detected at 11 of 12 sites (91.7%) and in 35 of 72 plant species (49%) across 18 plant families. Nine plant species collected were determined to be new host recordings. Maximum likelihood estimated rates of TSWV infection within individual species were generally very low (≤ 1.0%), when averaged over all survey locations, with the exception of the carpetweed (4.3%), mouse-ear chickweed (4.2%), common chickweed (1.4%), prickly lettuce (1.3%), spiny sowthistle (5.1%), dandelion (5.8%), blackseed plantain (3.4%), and smallflower buttercup (3.6%). These species were infected at ≥ 50% of the 10 or more locations in which they were sampled.

Infected plant species included perennial (N=10), biennial (N=4), and annual (N=21) plant species. Averaged over the fall season surveys, TSWV infection was detected most frequently in grouped samples of the perennials blackseed plantain and red sorrel, followed by the annual species Pennsylvania smartweed, spiny sowthistle, and common ragweed. Furthermore, many newly germinated winter annual species were found to be infected with TSWV at this time including Carolina geranium, henbit, wood sorrel, and common chickweed, although mean infection levels were low. Overall, the least number of TSWV infections were recorded in these fall surveys, averaging < 1 infected group sample/season across all 16 weed species surveyed.

Averaging over the winter surveys, plant species most often TSWV-infected included the perennial species mouse-ear chickweed and dandelion (20.5 samples/season) and annual species spiny sowthistle (13 samples/season) and common chickweed (12.2 samples/season), while the remainder of species tested averaged ≤ 7 TSWV-infected, group samples/season. The winter surveys produced the greatest mean number of infected group samples/season, averaging just over seven infected samples/season for the 15 different plant species surveyed.

Across each of the summer surveys, the most commonly infected perennials included dandelion (averaging 8.5 samples/season), blackseed plantain (7 samples/season), and red sorrel (5.3 samples/season). TSWV-infected annuals carpetweed, smallflower buttercup, ragweed, and Pennsylvania smartweed were also frequently infected, averaging 16.8, 5, 2, and 2 TSWV-infected grouped samples/season, respectively. Summer TSWV surveys yielded, on average, just under three TSWV-infected group samples/season across the 22 weed species surveyed. Results from our thrips population surveys over two years clearly demonstrate that a wide range of annual, biennial, and perennial plants are overwintering hosts for TSWV-vector species, but not all are equal in their ability to support reproducing populations of *F. fusca*.

Any assessment of the potential epidemiological importance of a particular plant species must also include some measure of the relative incidence of TSWV infection in that species. Our random TSWV surveys revealed a substantial number of plant species infected with TSWV. Although a substantial number of plant species were infected, not all of these species should be considered equally important as contributors in disease cycles. Clearly, understanding the relative importance of different potential transmission cycles is critical to optimizing any management strategy aimed at reducing the abundance of TSWV inoculum and spread into and potentially from crops. To more clearly identify those plant species likely of greatest importance in the transmission cycles of TSWV, we consolidated information from our surveys on suitability for reproduction by *F. fusca*,
and frequency of infection with TSWV into a single relative inoculum potential index (RIP) value for each plant species. It provides a basis for comparing the relative potential of various weeds included in our survey to serve as a source of inoculum for spread of TSWV in the areas and years in which we conducted our surveys. Vegetation management to reduce TSWV inoculum requires knowledge of the inoculum source within an area and of the dispersal of viruliferous thrips from that source. The implications of our research findings relative to recent detection(s) and widespread occurrence of Iris Yellow Spot Virus in New York onion production will be discussed.