

WINTER SURVEY OF THRIPS (THYSANOPTERA: THRIPIDAE) FROM CERTAIN SUSPECTED AND CONFIRMED HOSTS OF TOMATO SPOTTED WILT VIRUS IN SOUTH TEXAS

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ABSTRACT

A survey of peanut fields for thrips on selected and confirmed hosts of the tomato spotted wilt virus (TSWV) was conducted from November 24, 1986 to April 6, 1987. Berlese separators were utilized to extract thrips from plant samples. The only known thrips vector of TSWV collected during this study was *Frankliniella occidentalis*. Adult and immature forms of *F. occidentalis* were common on several weed hosts throughout the winter months. Twelve additional species of thrips were collected during the course of this study.

Key Words: Thrips, Tomato Spotted Wilt Virus, *Frankliniella* spp.

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INTRODUCTION

Spotted wilt disease (SWD) is caused by the tomato spotted wilt virus (TSWV). TSWV has a multitude of host plants worldwide, including tomato, pineapple, lettuce and peanuts. Currently 236 plant species representing 34 families are known reservoirs for TSWV (Cho et al. 1986; Best 1969).

TSWV was first reported from Texas peanuts by Halliwell and Philley (1974). The incidence of SWD on peanuts remained low until an outbreak occurred in Frio and Atascosa counties in South Texas during 1985, 1986 and 1987. Economic losses were considerable each of these years. A survey conducted for peanuts grown in Frio County indicates that yield losses exceeded \$5 million for the 1986 growing season (Gasch, personal comm.).

The first known report of transmission of TSWV by thrips was reported by Pittman (1927). Bald and Samuel (1931) found that adult thrips transmit TSWV only after feeding on infected plants while in the larval stage. Pittman (1927) reported that *Thrips tabaci* Lindeman could transmit the TSWV from infected to healthy plants; however *T. tabaci* did not vector TSWV in tomatoes and dahlias in controlled tests in Canada (Paliwal 1975). Other known thrips vectors that occur in North America include *Frankliniella occidentalis* Pergande and *Frankliniella fusca* (Hinds) (Sakimura 1962, 1963).

Both the pale and dark forms of *F. occidentalis* and *T. tabaci* transmitted TSWV from plant to plant in experiments with *Emilia sonchifolia* in Hawaii. No significant differences in transmitting efficiency were found between the color forms of *F. occidentalis*, *T. Tabaci* or between male and female thrips (Sakimura 1962).

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MATERIALS AND METHODS

Thrips were obtained from plants placed in Berlese separators. Six Berlese separators were constructed of 15.2 cm PVC water pipe cut into 25.4 lengths. Four-mesh hardware cloth (0.6 cm^2) was attached to one end of the PVC pipe and inserted into a plastic funnel. Paper tissues were saturated with formaldehyde and placed atop the plant material in each funnel. The funnels were then covered with plastic and allowed to sit for 24 hours. Alcohol jars were placed directly under the funnels to catch thrips and other insects which fell from the weed samples.

All thrips were identified by Charles Cole, co-author. Alcohol specimens were separated with the aid of a dissecting microscope and the number of each species recorded. Slide mounts of each species were made for each sample. Species determination was made with the aid of a compound microscope with phase-contrast and Nomarski Differential Interference Contrast capabilities. Taxonomic keys of Stannard (1968) and Bailey (1957) were used in determining thrips species.

Voucher specimens were placed in the Entomology Museum, Texas A&M University, College Station. Thrips identification and collection data are available from computer records.

Plant samples were randomly obtained from 3 peanut fields in Frio County and field margins which had severe SWD in 1987. Whole plant samples were placed in gallon Ziploc® bags for transporting to the Berlese separators. Although plant samples constituted sufficient volumes of material to fill one gallon Ziploc® bag per species on each sample date, samples were not quantitative since varying plant weights and ratios of flowers to leaves were placed in the separators. Annual and biannual species were collected within the field, whereas perennial species such as black nightshade, huisache and lantana were collected in field margins. A total of twelve plant species were sampled weekly between November 24, 1986 and April 6, 1987. Although weekly samples were taken, collection data are exhibited as biweekly collections. Plant species surveyed for thrips were known or suspected hosts for TSWV (Table 1). Certain species of cool season plants were sampled for thrips even though they had not been confirmed as a host for TSWV. Suspect plant species were chosen if they were closely related taxonomically to a known host or known host family such as Leguminosae, and if the species occurred in abundance.

RESULTS AND DISCUSSION

All plant species surveyed were not available each week for the duration of the survey. Although temperatures were relatively warm during the study (Table 2), a number of light freezes occurred during the latter half of January killing most annual plants, including resinweed, yellowtops, and pigweed. Dried flowers of these plants continued to serve as harborage for thrips and were sampled after the death of the plants. Peanuts are grown continuously in South Texas from early March through mid-December.

During April and May of 1986, the incidence of SWD in peanuts increased rapidly. The authors theorized that adult thrips migrating into peanut fields were from neighboring weeds infected with TSWV. Common weeds that are known reservoirs for TSWV growing during March, April and May in Frio County include yellowtops, prickly lettuce and American black nightshade. Suspect reservoirs for TSWV common during March, April and May include bluebonnet and bur clover.

Table 1. Confirmed or suspected native and cultivated plants that may serve as reservoirs for TSWV in South Texas during the winter months.

Plant Species	Common Name	Reference
<i>Solanum nigrum</i>	Black nightshade	Smith 1931
<i>Lactuca serriola</i>	Prickly lettuce	Black 1986*
<i>Verbesina enceloides</i>	Yellow tops	Cho, et al 1986
<i>Lupinus subcarnous</i>	Bluebonnet	suspected host
<i>Ambrosia psilostachyna</i>	Western ragweed	Black 1986 [†]
<i>Solanum tuberosum</i>	Potato	Smith 1931
<i>Arachis hypogea</i>	Peanut	Best 1968
<i>Medicago polymorpha</i>	Bur clover	suspected host
<i>Acacia farnisiana</i>	Huisache	suspected host
<i>Heterotheca subaxillaris</i>	Resinweed	suspected host
<i>Lantana horrida</i>	Lantana	suspected host
<i>Amaranthus retroflexus</i>	Pigweed	Milbrath 1939

* Confirmed by E.L.I.S.A. and mechanical transmission to indicator plant (cowpea).

[†] Confirmed by E.L.I.S.A. only.

Table 2. Average temperatures occurring at Charlotte, Atascosa Co., TX, November 1986 - April 1987.*

$\bar{x}$ Temperature °C	Nov	Dec	Jan	Feb	Mar	Apr
High	21.4	16.4	18.1	19.9	22.1	27.7
Low	10.6	7.4	4.6	7.9	7.9	10.6

* Climatological data from National Oceanic and Atmospheric Adm. (NOAA) Asheville, N.C., Vol's 91-92.

Thrips are common on peanuts throughout most of the growing season; however, the overwintering habitat of thrips in South Texas was unknown. The winter survey for thrips species that are known to transmit TSWV revealed that *F. occidentalis* was common on numerous hosts throughout the winter months (Table 3). Adult and larval thrips were common on American black nightshade, bur clover and prickly lettuce. Larval forms of *F. occidentalis* were found on weed hosts on all collection dates from November 24 - April 6 (Table 7).

F. fusca and *T. tabaci* were not collected from plant samples during the period of November 24 - April 6. *F. minuta* was recorded in relatively large numbers during the study but virtually no immatures were collected. Most *F. minuta* specimens (89%) were male, few females were collected during the study (Table 4).

Microcephalothrips abdominalis (D. L. Crawford), the third most common species following *F. occidentalis* and *F. minuta*, was collected from twelve species of plants but in relatively low numbers (Table 5). The majority of *M. abdominalis* specimens were male (86.3%) and were most numerous on yellowtops and resinweed. Immature forms of *M. abdominalis* were found on only two collection dates during the course

Table 3. Seasonal distribution of *Frankliniella occidentalis* on selected native and cultivated plants in Frio County, TX during November 24, 1986 to April 6, 1987.

Host	Nov		Dec		Jan		Feb		Mar		Apr	
	24-8	9-22	23-5	6-19	20-9	10-23	24-9	10-23	24-6	10-23	24-6	24-6
Resinweed	■	0*	■	■	0	-----	-----	-----	-----	-----	-----	-----
Yellowtops	■	■	■	0	■	-----	-----	-----	-----	-----	-----	-----
Lantana	■	■	■	■	-----	-----	-----	-----	-----	-----	-----	-----
Am. Black Nightshade	■	■	■	■	■	-----	-----	-----	-----	-----	-----	-----
Pigweed	■	■	■	■	-----	-----	-----	-----	-----	-----	-----	-----
Prickly Lettuce	---	■	■	■	■	-----	-----	-----	-----	-----	-----	-----
Bur Clover	---	---	■	■	■	-----	-----	-----	-----	-----	-----	-----
Bluebonnet	---	---	---	---	---	-----	-----	-----	-----	-----	-----	-----
Potato (Cultivated)	---	---	---	---	---	-----	-----	-----	-----	-----	-----	-----
Peanut (Volunteer)	---	---	---	---	---	-----	-----	-----	0	0	-----	-----
Huisache Tree (Blooms)	---	---	---	---	---	-----	-----	-----	-----	-----	-----	-----
Ragweed	---	---	0	■	■	-----	-----	-----	0	0	-----	-----
Percent Immatures	18.2	41.9	13.3	44.9	42.5	58.2	51.0	65.1	44.4	44.4	44.4	44.4

* 0 = No thrips collected from host plants --- = Host plants not available.

Table 4. Seasonal distribution of *Frankliniella minuta* on selected native and cultivated plants in Frio County, TX during November 24, 1986 to April 6, 1987.

Host	Nov		Dec		Jan		Feb		Mar		Apr	
	24-8	9-22	23-5	6-19	20-9	10-23	24-9	10-23	24-6	24-6	24-6	24-6
Resinweed	0*											
Yellowtops												
Lantana	0											
Am. Black Nightshade	---	0	0	0	0		0					
Pigweed	0	0										
Prickly Lettuce	---	0						0				
Bur Clover	---											
Bluebonnet	---							0				
Potato (Cultivated)	---											
Potato (Volunteer)	---											
Huisache Tree (Blooms)	---								0			
Ragweed	---											
Percent Immatures	0	0	0	0.5	0	0	0.9	6.5	0			

* 0 = No thrips collected from host plants --- = host plants not available.

Table 5. Seasonal distribution of *Microcephalothrips abdominalis* on selected native and cultivated plants in Frio County, TX during November 24, 1986 to April 6, 1987.

Host	Nov		Dec		Jan		Feb		Mar		Apr	
	24-8	9-22	23-5	6-19	20-9	10-23	24-9	10-23	24-6	10-23	24-6	24-6
Resinweed	██████████				0*							
Yellowtops	██████████											
Lantana	0	██████████	0	0								
Am. Black Nightshade	0	0	0	0	0	0	0	0	██████████	0	0	0
Pigweed	██████████	██████████	0	██████████	0	0	0	0	0	0	0	0
Prickly Lettuce	-----	██████████	██████████	██████████	0	██████████	0	██████████	██████████	0	0	0
Bur Clover	-----	-----	██████████	██████████	0	██████████	0	██████████	██████████	0	0	0
Bluebonnet	-----	-----	-----	-----	-----	0	0	0	0	0	██████████	██████████
Potato (Cultivated)	-----	-----	-----	-----	-----	0	0	0	██████████	0	██████████	██████████
Peanut (Volunteer)	-----	-----	-----	-----	-----	0	0	0	0	0	██████████	██████████
Huisache Tree (Blooms)	-----	-----	-----	-----	-----	-----	0	0	██████████	0	0	0
Ragweed	-----	-----	██████████	██████████	0	██████████	0	██████████	██████████	0	██████████	██████████
Percent Immatures	0	4.3	0	0.8	0	0	0	0	0	0	0	0

* 0 = Nc thrips collected from host plants --- = host plants not available.

of the study and in low numbers. *F. tritici* Fitch was collected throughout the winter but in low numbers (Table 6). Immature *F. tritici* were not collected in appreciable numbers until mid-March when reproduction of this species evidently began (Table 7).

Five additional species of thrips were collected in low numbers. *F. bruneri* Watson specimens collected during December and January were mostly from American black nightshade. The majority of adult specimens of *F. bruneri* (71%) collected from mid-December through mid-March, were female. No larval forms were collected during this period.

The four remaining thrips species collected during this study are *Chirothrips mexicanus* Crawford a seed feeder (2 specimens), *Caliothrips phaseoli* (Hood) a foliage feeder (1 specimen), *Neothrips* sp. a foliage feeder (1 specimen) and *Haplothrips mali* (Fitch) a predator (3 specimens).

The relationship of *F. occidentalis* with plants that are known reservoirs of TSWV such as yellowtops, American black nightshade and prickly lettuce during the winter months may be an important facet in the life history of the TSWV as related to peanut production in South Texas. *F. occidentalis* is the only known vector of TSWV that was collected from known or suspected reservoir host plants from November 24 - April 6, 1987. Reproduction of *F. occidentalis* was continuous during the winter months. Adult and larval thrips were relatively abundant on yellowtops, American black nightshade and prickly lettuce during the course of this study. This phenomenon could allow larval thrips to acquire the TSWV from infected plants and later function as vectors of the virus to volunteer and planted peanuts in the spring. Further investigations that concentrate on winter weed hosts that harbor the TSWV and its thrips vector must be conducted before conclusions can be made.

Table 6. Seasonal distribution of *Frankliniella tritici* on selected native and cultivated plants in Frio County, TX during November 24, 1986 to April 6, 1987.

Host	Nov		Dec		Jan		Feb		Mar		Apr	
	24-8	9-22	23-5	6-19	20-9	10-23	24-9	10-23	24-6	10-23	24-6	24-6
Resinweed	██████████			██████████	0*	-----		-----		-----		-----
Yellowtops	██████████	0	0	0	0	0	██████████		██████████		██████████	
Lantana	██████████	0	0	0	-----	-----						-----
Am. Black Nightshade	██████████	0	██████████	0	0	██████████	0	0	0	0	0	0
Pigweed	0	0	0	0	-----	-----						
Prickly Lettuce	-----	0	0	██████████	0	0	██████████		██████████		██████████	
Bur Clover	-----	-----	0	██████████			██████████		██████████		██████████	
Bluebonnet	-----	-----	-----	-----	-----	██████████	0		██████████		██████████	
Potato (Cultivated)	-----	-----	-----	-----	-----	0	██████████	0	██████████	0	██████████	
Peanut (Volunteer)	-----	-----	-----	-----	-----	0	0		██████████		██████████	
Huisache Tree (Blooms)	-----	-----	-----	-----	-----	-----	0		0	██████████	0	0
Ragweed	-----	-----	██████████	0	0	██████████	0		██████████		██████████	
Percent Immatures	0	0	13.9	0	0	0	0	0	52.1		30.3	

* = < 5% of total.

Table 7. Season occurrence of immature thrips on selected native and cultivated plants in Frio County, TX during November 24, 1986 to April 6, 1987.

Species	Nov		Dec		Jan		Feb		Mar		Apr	
	24-8	9-22	23-5	6-19	20-9	10-23	24-9	10-23	24-6	10-23	24-6	24-6
<i>Frankliniella occidentalis</i>												
<i>F. minuta</i>	0	0	0	*	0	0			*		0	
<i>M. abdominalis</i>	0	*	0	*	0	0	0	0	0	0	0	0
<i>F. tritici</i>	0	0	*	0	0	0	0					
<i>F. bruneri</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chirothrips mexicanus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Caliothrips phaseoli</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Neothrips</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0
<i>Haplothrips mali</i>	0	0	0	0	0	0	0	0	0	0	0	0

* = < 5% of total.

LITERATURE CITED

- Bailey, S. F. 1957. The thrips of California. Part I: Suborder Terebrantia. Bull. of the Calif. Insect Survey. Vol. 4, No.5.
- Bald, J. G., and G. Samuel. 1931. Investigations on "spotted wilt" of tomatoes. II Australian Common. Coun. Sci. Ind. Res. Org. Bull. 54.
- Best, R. J. 1968. Tomato spotted wilt virus. Advances in virus research. Vol 13: 65-145.
- Black, M. 1986. Extension Plant Pathologist, Tex. Ag. Ext. Serv., Uvalde, TX. Personal Communication.
- Cho, J. J., R. F. L. Mau, D. Gonsalves, and W. C. Mitchell. 1986. Reservoir weed hosts of tomato spotted wilt virus. Plant Disease 70 (11): 1014-17.
- Cho, J. J., W. C. Mitchell, R. F. L. Mau, and K. Sakimura. 1987. Epidemiology of tomato spotted wilt virus disease on crisphead lettuce in Hawaii. Plant Disease 71(6): 505-08.
- Cole, C. L. 1964. Thrips collected from native hosts of South Texas. Tx. J. of Sci. Vol. XVI(4): 446-48.
- Gasch, D. 1987. Frio Co., TX. County Extension Agent. Personal Communication.
- Halliwell, R. S., and G. Philley. 1974. Spotted wilt of peanut in Texas. Plant Disease Reporter 58(1): 23-5.
- Milbrath, J. A. 1929. Tomato tip-blight virus. Phytopath. 29: 156-68.
- Paliwal, V. C. 1975. Some characteristics of the thrips vector relationship of tomato spotted wilt virus in Canada. Can. J. Bot. 54: 402-05.
- Pittman, H. A. 1927. Spotted wilt of tomatoes. J. Australian Coun. Sci. and Indust. Res. 1: 74-7.
- Sakimura, K. 1962. *Frankliniella occidentalis* (Thysanoptera: Thripidae), a vector of the tomato spotted wilt virus, with special reference to the color forms. Ann. Entomol. Soc. Amer. 55: 387-89.
- Sakimura, K. 1963. *Frankliniella fusca*, an additional vector for the tomato spotted wilt virus with notes on *Thrips tabaci*, another vector. Phytopathology 53: 412-15.
- Smith, K. M. 1931. Virus diseases of plants and their relationship with insect vectors. Biol. Rev. 6: 302-44.
- Stannard, L. J. 1968. The thrips, or Thysanoptera of Illinois. Bull. Ill. Nat. Hist. Survey. Vol. 29, Article 4.
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