# Seasonal Abundance of Flower-Inhabiting *Frankliniella* Species (Thysanoptera: Thripidae) on Wild Plant Species

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**ABSTRACT** Flowers of 37 wild plant species located in North Florida were sampled at periodic intervals for selected thrips (Thysanoptera) species. Samples were collected from wooded areas adjacent to two tomato production fields over an 18-mo period beginning March 1989. Of the 2,583 thrips specimens collected, 78% were adults. Adult counts peaked in May at both sites during 1989 and 1990. The genus *Frankliniella* accounted for 87% of the adult thrips collected. The most common species collected was *F. tritici* (Fitch) followed by *F. bispinosa* (Morgan), *F. occidentalis* (Pergande), and *F. fusca* (Hinds). Species composition varied by sampled month. *Frankliniella tritici* was the most abundant species in March, May, and August; *F. bispinosa* in June and July; and *F. occidentalis* in February and April. The distribution of thrips that vector tomato spotted wilt virus was similar to that of nonvectors in flowers of wild hosts. Thrips were detected on 31 of the 37 wild plant species surveyed with 61% of all thrips collected inhabiting six plant species. *Frankliniella occidentalis* and *F. tritici* used a major proportion of the available wild plant species earlier in the season than *F. bispinosa* and *F. fusca*. All *Frankliniella* species exhibited a wide host range in April and May.

**KEY WORDS** *Frankliniella* species, wild plant hosts, seasonal abundance

THE FIRST PUBLISHED REPORT of western flower thrips, *Frankliniella occidentalis* (Pergande), in the lower southeastern United States was on cotton blooms in Georgia in 1981 (Beshear 1983). Tomato-spotted wilt virus, a serious disease of many agronomic and horticultural crops, was not present in the region before the appearance of *F. occidentalis*. In 1985, oviposition by large populations of female F. occidentalis on developing tomato fruit resulted in fruit scarring and serious economic loss to tomato producers in North Florida and South Georgia (Olson & Funderburk 1986). Recently, large populations of *F. occidentalis* have been observed on several agricultural crops in the region (Weeks et al. 1990, Salguero et al. 1991a, McPherson et al. 1992). Tomato spotted wilt virus has also reached epidemic proportions in tobacco (Culbreath et al. 1991), peanut (Hagan et al. 1990), and tomato (Kucharek et al. 1990). Because *F. occidentalis* inflicts direct cosmetic damage to fruits of several crops (Jensen 1973, Terry & DeGrandi-Hoffman 1988, Salguero et al. 1991b) and serves as a vector of tomato spotted wilt virus (Sakimura 1962), it has become a significant economic pest in the southeastern United States.

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The introduction of tomato spotted wilt virus to the southeastern United States has increased the potential for several endemic thrips species to inflict economic damage to agricultural production systems. Specifically, the tobacco thrips, *F. fusca* (Hinds) and onion thrips, *Thrips tabaci* Lindeman, are both efficient vectors of tomato spotted wilt virus (Sakimura 1963). Transmission by *F. bispinosa* (Morgan) has not been fully investigated.

Sound management of agricultural pests requires knowledge of pest biology on both the targeted commodity and in the surrounding plant community. Within commercial tomato production fields of North Florida, surveys revealed that 99% of all thrips species present in flowers were *F. occidentalis, F. fusca, F. tritici,* or *F. bispinosa* (Salguero et al. 1991a). The authors concluded that the population dynamics of each species were unrelated to crop phenology. A survey by Chamberlin et al. (1992) in South Georgia and North Florida indicated that within the vicinity of agricultural production fields, *F. occidentalis* and *F. fusca* may reproduce on numerous plant species. Both *F. fusca* and *F. occidentalis* have demonstrated the capability to feed on a wide range of plant species within the southeastern United States (Newsom et al. 1953, Chamberlin et al. 1992). In addition, both species are active during the winter months (Newsom et al. 1953,

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Harding 1961, Beckham et al. 1971, Chambers & Sites 1989).

The population dynamics of flower-inhabiting thrips species within a community of wild host plants and the extent to which coexisting thrip species utilize common resources is unknown in the southeastern United States. It is important to know if a shift in thrips species populations from wild hosts to cultivated hosts can occur. This study was undertaken to assess changes in the seasonal abundance of flower-inhabiting thrips species on wild plant species in the vicinity of tomato production areas in North Florida. To accomplish this, a survey of flowering wild plant species was conducted over an 18-mo period within wooded areas and hedge rows adjacent to two tomato production fields in north Florida.

## Materials and Methods

**Survey Procedures.** Wooded areas and hedge rows adjacent to two 5-ha tomato production fields (Farm B and M), located in Gadsden County, Florida, were sampled for thrips on 67 dates between 7 March 1989 and 17 August 1990. All identified plant species with open flowers within 0.5 km of the tomato fields were sampled. Three flowers from each of two plants were collected from each plant species on each sample date at each site. The large amount of time needed to collect and process samples prevented taking larger numbers of samples.

**Identification of Thrips Species.** Flowers were placed in vials containing 70% ethyl alcohol and taken to the laboratory for further processing. The contents of each vial was transferred to a petri dish and examined using 6.5–40× magnification. Flower structures were dissected to remove any thrips. A microscope slide was prepared for each thrips specimen using CMC-10 (Masters Chemical, Elk Grove Village, IL) as the clearing and preserving medium. The number of adult and immature thrips were determined only after 24 h clearing. Species of adult *Frankliniella* were determined using a key to the genus *Frankliniella* (R. J. Beshear, unpublished data).

**Data Analysis.** For each sample date, the total number of thrips collected on each plant species was divided by the number of flowers sampled to obtain the average number of thrips per flower. Sample data were summarized for each month to obtain monthly totals for *Frankliniella* species collected. The thrips species composition for each month and the number of plant hosts utilized by each thrips species was determined. Correlation analysis was used to measure the degree of association between abundance of thrips that are vectors of tomato spotted wilt virus and abundance of thrips that are not vectors in flowers of wild host plants. Because the data were not normally distributed, Spearman's rank correlation coefficient (Snedecor & Cochran 1980) was calculated using the BASIC program SPCOVAR.BAS written by Ludwig and Reynolds (1988).

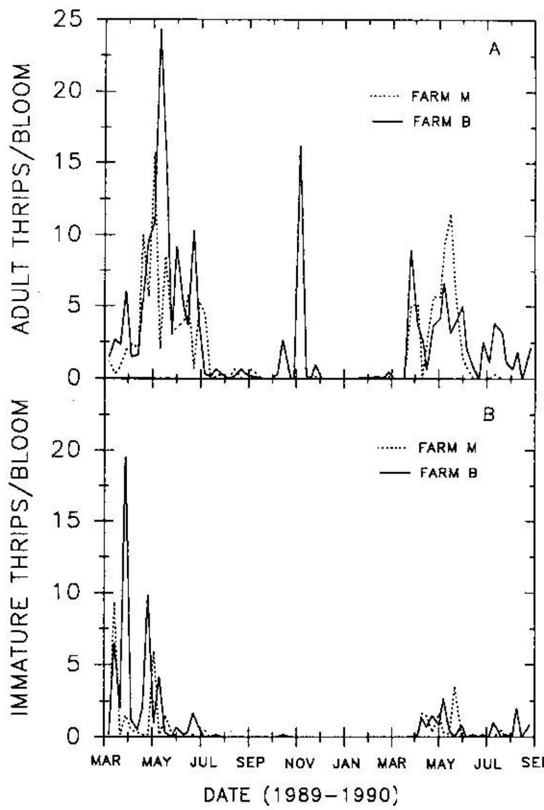


**Fig. 1.** Abundance of adult and immature thrips collected from flowers of wild hosts in wooded areas and hedge rows adjacent to tomato production fields. Values are summarized over hosts sampled for each date. Survey conducted between 7 March 1989–17 August 1990.

## Results

Of a total of 2,583 thrips extracted from 861 samples collected between 7 March 1989 and 17 August 1990, ≈78% were adults. Numbers of adult thrips peaked in May at both sites during 1989 and 1990 (Fig. 1A). The number of immature thrips peaked in March 1989 and May 1990 (Fig. 1B). Numbers of immature thrips species collected were much higher in 1989 than 1990. Except for one sample collected near Farm B on 20 October 1989, no immature thrips were collected between 25 July 1989 and 4 April 1990 (Fig 1B).

*Frankliniella* spp. accounted for 87% of the adult thrips collected. *Frankliniella tritici* was the most abundant adult species, followed by *F. bispinosa*, *F. occidentalis*, and *F. fusca*. The number of *F. tritici* were greatest in May in 1989

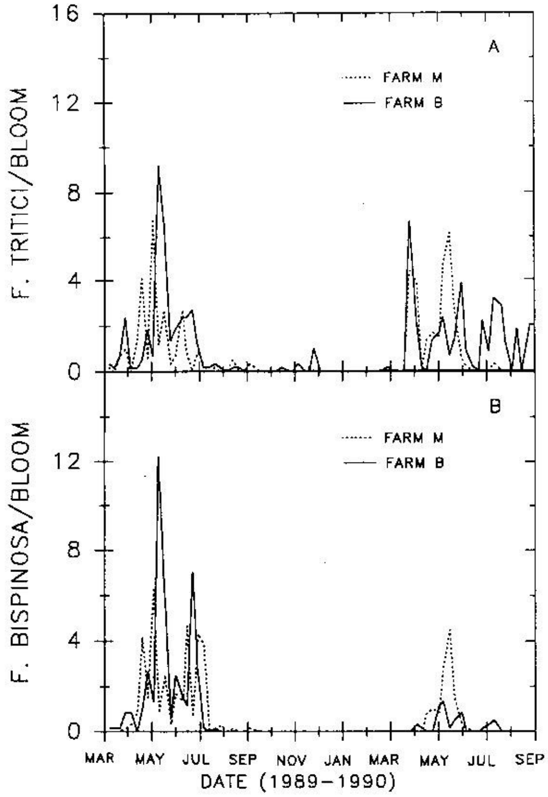


**Fig. 2.** Abundance of adult *Frankliniella tritici* and *F. bispinosa* collected from flowers of wild hosts in wooded areas and hedge rows adjacent to tomato production fields. Values are summarized over hosts sampled for each date. Survey conducted between 7 March 1989–17 August 1990.

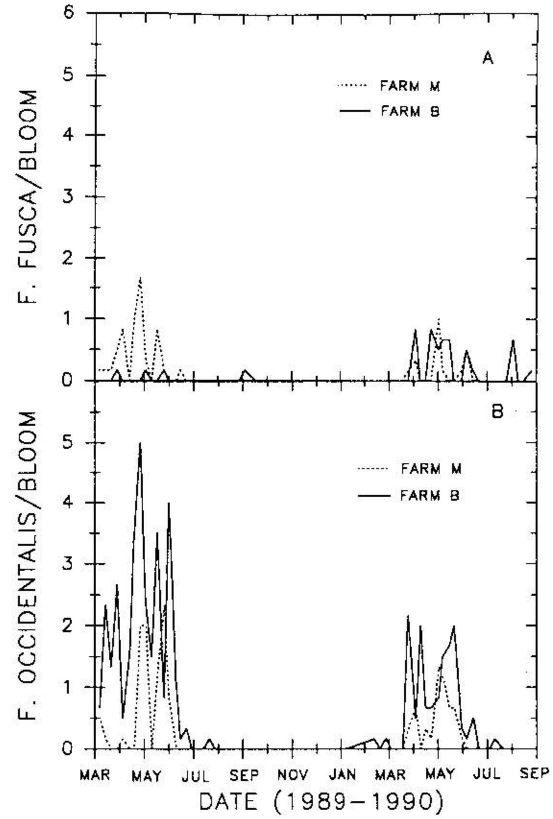


**Fig. 3.** Abundance of *adult Frankliniella occidentalis* and *F. fusca* collected from flowers of wild hosts in wooded areas and hedge rows adjacent to tomato production fields. Values are summarized over hosts sampled for each date, Survey conducted between 7 March 1989–17 August 1990.

and March in 1990 (Fig. 2A). In 1990, a second peak of *F. tritici* occurred in May near Farm M. Counts of *F. bispinosa* peaked in May in 1989 and 1990 at both sites (Fig. 2B). The most common other genus represented in the samples was *Microcephalothrips*, but numerous other genera were represented.

The number of *F. occidentalis* peaked in April 1989 and March 1990 near both farms (Fig. 3B). No *F. occidentalis* were collected between August and February. Near Farm M, numbers of *F. fusca* peaked in April in both 1989 and 1990 (Fig. 3A). In 1989, *F. fusca* numbers were low in samples collected near Farm B. In 1990, the number of *F. fusca* at that site was considerably greater and peaked in March and April. Very few *F. fusca* were collected between July of 1989 and March of 1990.

A total of 37 wild plant species was sampled (Table 1). Flower-inhabiting thrips were detected in 31 of the 37 wild plant species. Six plant species accounted for 61% of the thrips collected. In descending order, adult thrips were most numerous in flowers collected from wild radish (*Raphanus raphanistrum* L.), sand blackberry (*Rubus cuneifolius* Pursh), common vetch (*Vicia sativa* L), Japanese honeysuckle (*Lonicera japonica* Thumb.), hedgeprivet (*Ligustrum sinense* Lour.), and flowering dogwood (*Cornus florida* L.). *Frankliniella tritici, F. bispinosa, F. occidentalis*, and *F. fusca* were collected from flowers of 27, 25, 24, and 12 plant species, respectively.

The number of plant species in bloom was greatest during spring and early summer, and peaked in April (Table 2). *Frankliniella tritici* was present in the blooms of 50% or more of the flowering plant species identified in every month sampled except February. *Frankliniella bispinosa* was present in the blooms of 50% or more of the flowering plant species identified between April and June. *Frankliniella occidentalis* was present in the blooms of 50% to 100% of the plant species identified between February and May. *Frankliniella fusca* was present in

**Table 1. Wild plant species surveyed for presence of flower-inhabiting *Frankliniella* species in North Florida**

| Scientific name | Common name | Adult *Frankliniella* species collected |
|---|---|---|
| *Aleurites fordii* Hemsl. | tung-oil tree | None |
| *Conoclinium coelestinum* (L.) DC | mistflower | t[a] |
| *Cornus florida* L. | flowering dogwood | t, b, o |
| *Erigeron annuus* (L.) Pers. | daisy fleabane | t, b, o |
| *Eupatorium capillifolium* (Lam.) Small | dog fennel | f |
| *Ipomoea hederifolia* L. | scarlet morningglory | t, b |
| *Krigia virginica* (L.) Willd. | dwarf dandelion | t, b, o |
| *Lantana camara* L. | lantana | t, b, o |
| *Ligustrum sinense* Lour. | hedgeprivet | t, b, o, f |
| *Linaria canadensis* (L.) Dum.–Cours | Blue toadflax | t, b, o, f |
| *Lonicera japonica* Thunb. | Japanese honeysuckle | t, b, o |
| *Ludwigia octovalvis* (Jacq.) Raven | water primrose | t, b |
| *Malus angustifolia* (Ait.) Michx. | crab apple | t, b, o |
| *Oxalis corniculata* L. | creeping wood sorrel | t, o, f |
| *Oxalis florida* Salisb. | yellow wood sorrel | t, b, o, f |
| *Parthenium hysterophorus* L. | parthenium weed | t, b |
| *Prunus angustifolia* Marsh. | chickasaw plum | b, o, f |
| *Prunus serotina* J.F. Ehrh. | wild cherry | t, b, o |
| *Pyrrhopappus carolinianus* (Walt.) DC. | false dandelion | t, b, o, f |
| *Raphanus raphanistrum* L. | wild radish | t, b, o, f |
| *Richardia scabra* L. | Florida pusley | None |
| *Rosa multiflora* Thunb. ex J. Murr. | multiflora rose | t, b, o |
| *Rubus cuneifolius* Pursh | sand blackberry | t, b, o, f |
| *Salpichroa origanifolia* (Lam.) Baill. | cock's eggs | None |
| *Sassafras albidum* (Nutt.) Nees | sassafras | t |
| *Senna obtusifolia* (L.) Irwin & Barneby | sicklepod | None |
| *Sida rhombifolia* L. | arrowleaf sida | t, b, o |
| *Sonchus asper* (L.) Hill | prickly sowthistle | None |
| *Tagetes minuta* L. | wild marigold | None |
| *Trifolium campestre* Schreb. | large hop clover | t, b, o, f |
| *Trifolium incarnatum* L. | crimson clover | t, o |
| *Triodanis perfoliata* (L.) Nieuwland | Venus' looking-glass | t, b, o. f |
| *Vaccinium arboreum* Marsh. | sparkleberry | b |
| *Verbena tenuisecta* Briq. | moss verbena | b, o, f |
| *Verbena brasiliensis* Vell. | Brazilian verbena | t, b, o |
| *Vicia sativa* L. | common vetch | t, b, o |
| *Wisteria sinensis* (Sims) Sweet | Chinese wisteria | t, b, o |

[a] t = *F. tritici*, b = *F. bispinosa*, o = *F. occidentalis*, and f = *F. fusca*.

blooms of 50% or more of the plant species identified in April. Immature thrips species were present in the blooms of at least 60% of the wild plant species identified in March, April, and May.

The composition of adult thrips collected varied from month to month. In March the majority of adult thrips were *F. tritici* (Table 3). In April, *F. occidentalis, F. bispinosa,* and *F. tritici* each accounted for about 25% of the adult thrips collected. In May the majority of species collected were either *F. tritici* or *F. bispinosa*. In June and July the majority were *F. bispinosa* while in August the majority of thrips were *F. tritici*.

In March and April there was a significant ($P = 0.10$) positive correlation between abundance of thrips that are vectors of tomato spotted wilt virus and abundance of nonvectors (Table 4). No correlation between abundance of tomato spotted wilt virus vectors and nonvectors was ob-

**Table 2. Temporal changes in host range of flower-inhabiting *Frankliniella* species**

| Month[a] | Plant species sampled | Proportion of plant species utilized | | | | | |
|---|---|---|---|---|---|---|---|
| | | *occidentalis* | *bispinosa* | *tritici* | *fusca* | Other genera | Immature thrips |
| February | 4 | 0.50 | 0 | 0.25 | 0 | 0.25 | 0 |
| March | 16 | 0.75 | 0.31 | 0.81 | 0.25 | 0.44 | 0.69 |
| April | 24 | 0.50 | 0.67 | 0.58 | 0.62 | 0.33 | 0.62 |
| May | 15 | 1.00 | 0.87 | 0.93 | 0.47 | 0.73 | 0.80 |
| June | 15 | 0.40 | 0.87 | 0.67 | 0.07 | 0.33 | 0.47 |
| July | 13 | 0.15 | 0.46 | 0.61 | 0.08 | 0.23 | 0.46 |
| August | 5 | 0 | 0.40 | 0.80 | 0.40 | 0.40 | 0.20 |
| October | 1 | 0 | 0 | 1.00 | 0 | 1.00 | 1.00 |
| November | 3 | 0 | 0 | 0.67 | 0 | 0.67 | 0 |

[a] No samples were taken during January, September, and December.

**Table 3. Temporal changes in species composition of samples collected between February and August**

| Month | *Frankliniella* species | | | | Other genera |
|---|---|---|---|---|---|
| | *occidentalis* | *bispinosa* | *tritici* | *fusca* | |
| February | 0.40[a] | 0 | 0.20 | 0 | 0.40 |
| March | 0.29 | 0.05 | 0.56 | 0.06 | 0.04 |
| April | 0.29 | 0.24 | 0.25 | 0.09 | 0.14 |
| May | 0.19 | 0.33 | 0.38 | 0.03 | 0.07 |
| June | 0.05 | 0.55 | 0.37 | <0.01 | 0.02 |
| July | 0.05 | 0.52 | 0.28 | 0.07 | 0.08 |
| August | 0 | 0.06 | 0.73 | 0.06 | 0.14 |

[a] Proportion of thrips identified as *F. occidentalis*, *F. bispinosa*, *F. tritici*, *F. fusca*, or other genera.

served in May and June. As a result of the large number of samples in which no thrips were detected, correlation coefficients were not calculated for February, July, August, and October.

## Discussion

Flower-inhabiting thrips species were most abundant between March and June. With the exception of July, abundance of thrips peaked in months when the diversity of wild hosts with flowers was greatest. Thrips numbers declined drastically in July, although an ample number of flowering plant species were still available. We do not know whether mortality or physiological factors (i.e., diapause) were responsible for the observed decline. Similar trends of seasonal abundance have also been observed for phytophagous thrips inhabiting tobacco foliage in Georgia (McPherson et al. 1992). Trends in the seasonal abundance of *Frankliniella* spp. were similar between the two sites although the magnitude of thrips collected was greater near farm B. Changes in the abundance of *F. occidentalis* were similar to changes in other *Frankliniella* spp. However, it appears that numbers of *F. occidentalis* increased earlier in the year, followed by *F. fusca*, *F. tritici*, and *F. bispinosa*.

Chamberlin et al. (1992) collected *F. occidentalis* from 44 plant species in northern Florida and southern Georgia during late winter and spring. We identified 17 additional hosts for *F. occidentalis* in this same geographical region. Data from both studies suggest that populations of *F. occidentalis* are well established by the time cultivated hosts such as tomato or peanut became available. Chamberlin et al. (1992) reported 32 hosts for *F. fusca* in this region. We collected *F. fusca* from 11 additional hosts. Seasonal trends in abundance of *F. tritici* and *F. bispinosa* were similar to changes in seasonal abundance of these species observed in Georgia (Webb et al. 1970) and South Carolina (Watts 1937).

**Table 4. Relationship between abundance of vectors and nonvectors of tomato spotted wilt virus in flowers of wild plant species**

| Month | df[a] | rs[b] |
|---|---|---|
| March | 14 | 0.489* |
| April | 22 | 0.340* |
| May | 13 | 0.364 |
| June | 13 | 0.369 |

[a] Number of plant species sampled—2.
[b] Spearman's rank correlation coefficient, asterisk denotes values are significant at $P = 0.10$.

In this study, *Frankliniella* spp. were more abundant and utilized more wild plant hosts than all other genera of flower-inhabiting thrips combined, and appear to be the dominant genera of flower-inhabiting thrips on wild plant species in North Florida. *Frankliniella* also has been reported to be the dominant genera of flower-inhabiting thrips within tomato fields from the same geographic region (Salguero et al. 1991a). Thus, it appears that the composition and density of flower-inhabiting thrips populations within tomato fields are similar to the composition and density of populations in the surrounding plant community.

Relative to other *Frankliniella* spp., *F. occidentalis* was more abundant and able to utilize the flowers in a larger proportion of the available plant species earlier in the season than other thrips species. These observations indicate that *F. occidentalis* becomes well established in the wild plant community earlier in the year and that tomato spotted wilt virus susceptible crops planted in the vicinity of flowering wild hosts will be colonized and possibly infected if viruliferous thrips migrate from wild to cultivated hosts. Because *F. fusca* is considered primarily a foliage feeder, it was surprising that this species was found in flowers of 62% of the wild host species sampled in April.

Abundance of thrips that vector tomato spotted wilt virus were positively correlated to the abundance of thrips that do not vector the virus in March and April. We suggest that when blooms of wild plant species contain high numbers of thrips, it is reasonable to assume that those plants will also contain a high number of thrips that vector tomato spotted wilt virus. This information is valuable in the development of a sound pest management strategy against known vectors of tomato spotted wilt virus such as *F. occiden-*

*talis* and *F. fusca*. Using this knowledge, wild plant hosts with high populations of flower inhabiting thrips could be targeted for removal, pesticide application, or surveyed for the detection of tomato spotted wilt virus. Additional studies examining the fate of *F. occidentalis* between July and February must be conducted before pest management strategies designed to break the life cycle can be implemented.

The current study is significant because it documents changes in the abundance of flower-inhabiting thrips species in the wild plant community over an extended (18 mo) period. The data clearly shows the dominance of *Frankliniella* species among the flower-inhabiting thrips population and reveals a large reservoir of potential hosts for vectors of tomato spotted wilt virus.

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