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FLOWER THRIPS (THYSANOPTERA: THRIPIDAE) COLLECTED FROM VEGETABLES, ORNAMENTALS AND ASSOCIATED WEEDS IN SOUTH FLORIDA

GALEN FRANTZ AND H. CHARLES MELLINGER Glades Crop Care, Inc. 949 Turner Quay Jupiter, FL 33458

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Abstract. Following the outbreak of Western Flower Thrips, *Frankliniella occidentalis* (Pergande), in north Florida in 1985, collections of thrips were made from various crops and weeds in south Florida in an effort to detect this potentially damaging pest. Between 1986 and 1990 them collections contained primarily *F. bispinosa* (Morgan) among 25 species collected. Collections made in May 1990 indicated Western Flower Thrips were displacing *F. bispinosa* on the east coast of Florida and had moved into the Belle Glade and west coast areas as well. Although the 2 main vector of Tomato Spotted Wilt Virus in Florida were detected, this disease was only found in a situation which suggests that Tobacco Thrips, *Frankliniella fusca* (Hinds), may be the more important vector.

Thrips are a diverse group of insects, inhabiting a variety of plants from cultivated crops to woodlands, and from flowers to fungi. Most are plant feeders but a few are predaceous. Thrips cause economic damage, either by feeding and egg laying activity, or as vectors of Tomato Spotted Wilt Virus (TSWV), which threatens numerous crops worldwide (5,7).

Thrips damage has been recorded in Florida for nearly 100 years. Quaintance (4) noted the incidence of 2 species, *Thrips tritici*, Osborn (Fitch) on strawberries and fruit crops, and *Thrips tabaci* Lindeman on onions and cole crops. In 1912 Watson (8) reported heavy damage to tomato blossoms by *Frankliniella* (= *Euthrips*) tritici. Ten years later Watson (9) presented details of *Frankliniella bispinosa* Morgan, which he equated to Quaintance's *T.* tritici based on an illustration in Quaintance's report (4). Watson described damage caused by *F. bispinosa* on citrus, strawberries, and tomatoes, among other crops. The tomato damage consisted of a blackening, withering and eventual shedding of blossoms when infested by high numbers of thrips.

In May 1985, an unusual blemish was observed on tomato fruits grown in Gadsden County, Florida. This consisted of a small puncture, surrounded by a slightly raised white area, 3-7 mm in diameter. Most blemishes disappeared as the fruit turned red, but economic losses were reported. Similar damage was observed in Collier County, Florida in the winter and spring of 1985-86 (Glades Crop Care, Inc. unpublished data). At the time different theories of the cause were offered, e.g., disease, environmental stress or insect activity. However, in 1989, Funderburk and Salguero (2) determined the blemishes resulted from oviposition by the Western Flower Thrips (WFT), *Frankliniella occidentalis* (Pergande). A commonly occurring blemish in Collier County, consists of a simple puncture, without the surrounding white tissue. This damage appears after high numbers of thrips have been in the field.

Another type of thrips damage was observed in May 1990, when pepper fruits were found infested with high numbers of thrips. The thrips congregated in large numbers where fruits or leaves were in contact with each other. The feeding resulted in patches of scar tissue 1-3 cm in diameter.

In May 1986, the authors discovered TSWV infecting tomatoes in the Gadsden County area and this was published by the Florida Division of Plant Industry (DPI) (3). The level of TSWV infection was between 0.1 and 1 % for most fields and at least three fields had over 10% infected plants at harvest. At that time Glades Crop Care, Inc. (GCC) determined that to apprise vegetable growers of the risk of TSWV incidence, a survey of thrips in and around the fields serviced should be undertaken.

Denmark (1) indicated WFT had been collected in Florida since 1982, citing ornamental plants as commonly infested hosts. He also reported the collection of WFT from field crops in 1985 from the panhandle area. Subsequent collections of WFT by the DPI continue to show this association with ornamentals; and, most collections occur in the Orlando, Tampa and Florida East Coast growing areas, and at Miami by way of California (H. Denmark, FL Div. of Plant Industry, personal communication).

The immediate objective of this study was to survey the species composition of thrips populations in the vegetable growing areas of south and southwest Florida populations, in order to determine when WFT or other TSWV vectors would be present. The overriding goal was to prepare vegetable and ornamental growers and their pest management programs for the potential of TSWV in south Florida. The east coast production area was first represented in the survey in the spring of 1990, when collections were submitted by GCC personnel in Dade County and by Kenneth Schuler, Palm Beach County Extension Agent.

Materials and Methods

Thrips were removed from host plants with a moistened brush or the frayed end of a paper match and placed in 70% isopropyl alcohol. Thrips were collected from small flowers, e.g., tomato and *Bidens pilosa* by tapping the flowers over the lip of the collection vial or submerging the flowers until the thrips were dislodged.

Collections were made at irregular intervals, the date being most often determined by the presence of thrips in the field. Most collections involved gathering thrips from at least 20 host plants or flowers.

Thrips were identified by examining slide mounted specimens with a compound microscope. Temporary mounts were made in 1986 and 1987 using either Hoyer's solution or CMC-10 (Master's Chemical Co., Inc., 520 Bonnie Lane, Elk Grove, IL 60007). Beginning in 1988 temporary mounts were used for the commonly collected species, when permanent specimens were not required. Otherwise, specimens were mounted in balsam on glass slides for a permanent record.

In a few large collections from weeds of 1989 and 1990, the *Frankliniella bispinosa* and *F. cephalica* species were separated from other *Frankliniella* spp. under 43X magnification, counted and discarded. The trait used for separation was the presence of heavy setae on the second antennal segment which is produced over the base of the 3rd segment. The other *Frankliniella* spp. from these collections were mounted and examined as described above. As a result an enumeration of species from weeds was not made. The results of the weed survey, consisting of host records, are presented in Table 1. A series of voucher specimens has been submitted to the Department of Entomology, Division of Plant Industry, Gainesville, FL.

Results and Discussion

The thrips species collected and identified in this survey are listed in Table 1. The most diverse group was the genus *Frankliniella* Karny with 10 species. *F. bispinosa* was the most prevalent species in all areas (Tables 1, 2, 3, 4, 5) with one exception: *F. occidentalis* was most common on the east coast of Florida during the spring of 1990 (Table 4).

The first collection of WFT in the Florida west coast area occurred in July 1989. WFT was sporadically collected through July 1990. Its low incidence on the west coast suggests WFT may be a recent immigrant or only poorly established. The presence of WFT-like oviposition damage (Glades Crop Care, Inc. unpublished data) on tomato fruit in 1986 in the Naples-Immokalee area suggests WFT was in that area prior to the initiation of this survey, but that populations were undetectably low in 1987 and 88. Such fluctuations in species abundance have been observed in Quincy, Florida by Funderburk and Salguero (2) and Glades Crop Care, Inc. (unpublished data).

The other previously mentioned tomato blemish, consisting of simple puncture without the surrounding white tissue, was observed throughout the survey period in tomato fields infested with *F. bispinosa*. This circumstantial evidence that *F. bispinosa* is responsible for this type of damage is supported by the appearance of these simple punctures on fruits of tomatillo in Collier County. *F. bispinosa* was collected from tomatillo flowers prior to fruit expansion and on the day the punctures were noted. It is likely other thrips species were excluded from the flower or ovaries by the papery wrapper typical of this fruit.

The scarring of pepper fruits was only observed in Palm Beach County. WFT were collected from these damaged fruits. WFT also occurred in very high numbers (>25/bloom) in pepper flowers in the same field.

Since a high proportion of the population was made up of WFT in the east coast areas, this species appears to be fairly well established there. The numerous ornamental nurseries in Palm Beach County may explain the higher numbers of WFT in that area. A similar circumstance occurred in Florida in 1986-87 when the sweet potato whitefly, *Bemisia tabaci* (Gennadius) became established and reached economic levels on ornamentals before invading surrounding vegetable growing areas (6).

F. fusca was present in all the collection areas, albeit at low levels. This was important because it indicated the presence of one or more TSWV vectors in the south Florida farming area at least on an irregular basis. This was supported by the sporadic incidence of TSWV in south Florida (L. Brown, FL Div. of Plant Industry, personal communication). The only widespread incidence of TSWV observed by the authors in south Florida involved a peanut field sampled 15 May 1990 in Belle Glade, Florida. The field had side-by-side, 5 acre plantings of corn, peanuts, lima beans and black-eyed peas. A11 4 hosts were infested with WF*T.* Despite extensive searching, however, TSWV was detected only in the peanut crop, which was also infested with *F. fusca*. Extensive sampling in Palm Beach County resulted in no further sign of TSWV, despite the high WFT populations. It would appear that *F. fusca* may currently be the more important vector of TSWV in this area.

Thrips collections from ornamentals, primarily chrysanthemums, showed a pattern similar to that observed in vegetables. *F. bispinosa* outnumbered other species. The next most common species on chrysanthemum was *Microcephalothrips abdominalis*, the composite thrips. This species was also abundant on the composite weed, *Bidens pilosa*. Other *Frankliniella* species, *F. fusca, F. insularis* and *F. kelliae* occurred infrequently.

WFT was collected on 3 occasions from ornamentals (Table 5). The following example is intriguing. A Charlotte County chrysanthemum farm was sampled 25 Apr. 1990 and *F. bispinosa* and *M. abdominalis* were present. On 28 Apr. 1990, a Lee County flower farm was sampled and *F. bispinosa* and *F. kelliae* were present. A sample was also taken from severely damaged potted mums inside a large shopping mall in Lee County, Florida, and only WFT were found. Subsequently, it was learned that these flowers originated on the Charlotte County flower farm. However, the grower received no complaints from any customers about thrips infesting the potted mums. Additional observations of the Charlotte County potted mums by Glades Crop Care, Inc. at retail outlets and at other local sites showed no development of thrips in the flowers. The severely damaged mums in the mall had apparently become infested from other interiorscape plantings, or from the garden center inside the mall.

This incident dramatically illustrates the importance of the movement of plant material in and out of such areas as malls, garden shops or greenhouses in the dissemination of plant pests. When WFT were finally collected at the Lee County flower farm on 11 May 1990, they were found in a greenhouse on plants bought from an area known to have an established WFT population.

Other notable collections from ornamentals include *Echinothrips americanus* which was an occasional pest in greenhouses. *Hercinothrips femoralis* was collected from dooryard Crinum lilies which annually suffered significant foliage damage caused by high numbers of these thrips.

Collections from weeds showed the same pattern as cultivated crops, with *F. bispinosa* the most common thrips present. Unfortunately, to save time in processing large samples, *F. bispinosa* was not separated from *F. cephalica* in collections from *Bidens pilosa* made on 5 July 1989 and in some April and May collections of that year. However, it was observed that WFT were found in weeds at the same time that they were present in nearby crops.

These observations show WFT to be present in readily detectable numbers in Palm Beach County, and sporadically present in other south Florida growing areas. This survey was beneficial in that WFT was found in southwest Florida before overwhelming numbers had developed; thus, growers can anticipate well founded information for their crop management plans regarding thrips and the Tomato Spotted Wilt Virus disease. The survey also demonstrated that during Apr. and May 1990 WFT had effectively displaced *F. bispinosa* as the dominant flower thrips in some east coast areas. Furthermore, important relationships were observed regarding movement of plant pests with plant material. Finally, TSWV was observed in a situation that suggested *F. fusca* was the more important of the 2 vectors present.

In addition to collecting directly from host material, the survey work was recently expanded to include water pan trapping in an effort to eliminate sample bias and to provide a more continuous record.

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Table 1. Thrips collected in South Florida, 1986-90.

Species	Months collected	Hosts
Bregmatothrips venustus Hood	May	Grasses
Chiropthrips mexicanus Crawford	May, Jul, Aug, Sept, Oct	Chrysanthemum, tomato, weeds
Echinothrips americanus Morgan	Apr	Chrysanthemum
Frankliniella bispinosa (Morgan)	Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	Baby's breath, *Bidens pilosa*, blackberry, black-eyed pea, cat tail, chrysanthemum, corn, cucumber, eggplant, elderberry, gloxinia, grasses, ground cherry, iris, Leguminosae, lima bean, Lippia sp., Melaleuca sp., nightshade, oak, peanut, pepper, Persian violet, primrose, willow, ragweed, sedges, Sesbania sp., Tabebuia sp., Tillandsia sp., tomatillo, tomato, strawberry, watermelon
F. cephalica (Crawford)	Mar, Apr, May, Jun, Jul, Aug	*Bidens pilosa*, tomato, mangrove
F. fusca (Hinds)	Mar, Apr, May, Jun, Jul, Aug	*Bidens pilosa*, chrysanthemum, cucumber, grasses, lettuce, Lippia sp., parsley, peanut, pepper, tomato, water hyacinth
F. insularis (Franklin)	Feb, May, Jun	Black-eyed pea, gloxinia, hibiscus, Leguminosae, Tabebuia sp., tomato
F. kelliae Sakimura	Mar, Apr, May	Chrysanthemum, confederate jasmine, pepper, tomato

F. occidentalis (Pergande)	Apr, May, Jul	*Bidens pilosa*, black-eyed pea, bok choi, chrysanthemum, corn, cucumber, eggplant, gloxinia, lettuce, lima bean, parsley, peanut, pepper, squash, tomato, watermelon, weeds
F. schultzei Trybom	Jun	Pickerel weed
F. tenuicornis (Uzel)	May, Jun	Cat tail
F. tritici (Fitch)	Jun	Water hyacinth
F. williamsi Hood	Apr, May	Corn
Frankliniella sp.	Apr, Jun	Carrot, cucumber, grasses, pepper
Hercinothrips femoralis (Reuter)	May	Crinum sp.
Leucothrips pierci (Morgan)	Nov	Bok choi
Microcephalothrips abdominalis (Crawford)	Feb, Mar, Apr, May, Jun, Oct, Nov	*Bidens pilosa*, chrysanthemum, Coreopsis sp., Leguminosae, ragweed, tomato, weeds
Organothrips indicus Bhatti	Apr, Jun	Cat tail, pickerel weed, water hyacinth
Plesiothirps perplexus (Beach)	Apr	Cat tail
P. typhae Hood	May	Cat tail
Pseudothrips inequalis (Beach)	Apr, May	Tomato, willow
Scolothrips sp.	Jun	Nightshade
Sericothrips variabilis Beach	Jun	Ragweed
Thrips hawaiiensis (Morgan)	Apr	Cucumber
Thrips sp.	Jun, Aug, Sept	Confederate jasmine
Tubulifera	Apr, May, Jul	*Bidens pilosa*, cat tail, sedges, weeds

Table 2. Summary of economically important thrips collected from vegetables in Collier, Hendry, and Lee Counties, 1986-90.

Growing season (Sept.-Aug.)	Number of collections	Number of hosts	*Frankliniella bispinosa*	*F. fusca*	*F. occidentalis*	Other
1986-87	11	6	102[Z] (94.4)[Y]	5 (4.6)	0 (0)	1 (0.9)
1987-88	4	1	47 (97.9)	0 (0)	0 (0)	1 (2.1)
1988-89	3	1	57 (96.6)	0 (0)	0 (0)	2 (3.4)
1989-90	27	6	673 (91.8)	0 (0)	35 (4.8)	25 (3.4)
1990-	6	5	127 (97.7)	0 (0)	0 (0)	3 (2.3)

[Z]Number collected
[Y]% of total for the season (may not add up to 100% due to rounding)

Table 3. Summary of economically important thrips collected from vegetables in DeSoto and Manatee Counties, 1986-90.

Growing season(Aug.-July)	Number of collections	Number of hosts	*Frankliniella bispinosa*	*F. fusca*	*F. occidentalis*	Other
1986-87	13	1	329[Z] (99.1)[Y]	2 (0.6)	0 (0)	1 (0.3)
1987-88	3	1	39 (88.6)	1 (2.3)	0 (0)	4 (9.1)
1988-89	2	1	36 (100)	0 (0)	0 (0)	0 (0)
1989-90	7	2	313 (94.0)	13 (3.9)	0 (0)	7 (2.1)
1990-	3	2	63 (100)	0 (0)	0 (0)	0 (0)

[Z]Number collected

[Y]% of total for the season

Table 4. Summary of economically important thrips collected from vegetables in Dade, Martin, Palm Beach Counties, 1986-90.

Growing season (Sept.-Aug.)	Number of collections	Number of hosts	*Frankliniella bispinosa*	*F. fusca*	*F. occidentalis*	Other
1986-87	1	1	4[Z] (66.7)[Y]	1 (16.7)	0 (0)	1 (16.7)
1987-88	-	-	-	-	-	
1988-89	1	1	3 (75.0)	0 (0)	0 (0)	1 (25.0)
1989-90	22	12	117 (10.0)	33 (2.8)	1005 (85.5)	21 (1.8)
1990-	1	1	11 (73.3)	0 (0)	0 (0)	4 (26.7)

[Z]Number collected
[Y]% of total for the season (May not add up to 100% due to rounding)

Table 5. Summary of economically important thrips collected from ornamentals in Charlotte and Lee Counties, 1986-90.

Growing season (Aug.-July)	Number of collections	Number of hosts	*Frankliniella bispinosa*	*F. fusca*	*F. occidentalis*	Other
1986-87	16	8	112[Z] (81.2)[Y]	1 (0.7)	0 (0)	25 (18.1)
1987-88	1	1	1 (9.1)	0 (0)	0 (0)	10 (909)
1988-89	3	1	41 (93.2)	0 (0)	0 (0)	3 (6.8)
1989-90	12	6	228 (80.6)	0 (0)	30 (10.6)	25 (8.8)

[Z]Number collected
[Y]% of total for the season