

Thysanoptera Collected during Bloom on White and Colored Disposable Sticky Cards in Florida Citrus Groves¹

C. C. Childers, S. Nakahara² and R. J. Beshear³

University of Florida, IFAS, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, Florida 33850 U.S.A.

J. Entomol. Sci. 33(1): 49-71 (January 1998)

Abstract During February through April between 1990 and 1993, 86 species of thrips (Thysanoptera: Terebrantia and Tubulifera) were identified from disposable colored sticky cards in navel orange groves in Polk and Osceola counties (46 species) and Hendry and Lee counties (75 species) in central and southwestern Florida, respectively. Only 33 species were collected in both central and southwestern Florida. Of the 86 species identified, 37 are phytophagous of which 12 feed on plants of the Graminae, 17 are known predators or species belonging in genera that include predators, 28 species are fungivorous or saprophytic and the feeding habits of the remaining 4 species are unknown. *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) was the most prevalent species on sticky cards during 1990 with frequencies of 82 and 79% of slide-mounted specimens identified from the Hendry Co. sites, respectively. During 1991, *F. bispinosa* accounted for 91 and 96%, respectively, of the slide-mounted specimens from the Chain-O-Lakes and Raley sites in central Florida. During 1992, *F. bispinosa* accounted for 95% of the identified *Frankliniella* species from the southwest Florida site compared with 5% of *F. kelliae* Sakimura. During 1993, *F. bispinosa* accounted for 96 and 98% of the slide-mounted thrips identified from two series of experiments using different colored cards in southwest and central Florida, respectively.

During 1990 in southwest Florida, other thrips species collected from sticky cards with frequencies of 1% or more included: *Arorathrips spiniceps* (Hood) (3%), *Microcephalothrips abdominalis* (Crawford, D. L.) (1%), *Adraneothrips pallidus* (Watson) (1%), *Gastrothrips callipus* Hood (3%), *Hoplandrothrips raptor* (Crawford) (4%), *Leptothrips cassiae* Watson (1%), *L. macrocellatus* Watson (2%), and *Neurothrips magnafemoralis* (Hinds) (1%).

During 1991 in central Florida, other thrips species collected from sticky cards with frequencies of 1% or more included: *A. spiniceps* (2%) and *M. abdominalis* (1%). In 1992, thrips species collected in Hendry Co. included: *A. spiniceps* (2%), *F. insularis* (Franklin) (10%), *F. kelliae* Sakimura (4%), *M. abdominalis* (3%), and *Adraneothrips pallidus* (4%).

Key Words Thysanoptera, sticky cards, Terebrantia, Tubulifera, traps, citrus, color, attraction.

Declining yields on 'Tahiti' lime trees were first recognized in 1983 in the vicinity of Immokalee in Lee Co., FL. Increasing fruit losses were reported through 1987 on lime as well as on 'Valencia' and navel orange varieties in Dade, Martin, Collier, Hendry, Lee and DeSoto counties (Childers et al. 1990). Flowers had distinct pink to grayish spots on the petals and, in many groves, there were enlarged calyces or buttons of

¹Received 19 December 1996; accepted for publication 10 July 1997.

²USDA, ARS, Systematic Entomology Laboratory, Beltsville, MD 20705-2350.

³512 Nail Rd, McDonough, GA 30253.

infected flowers that remained on the trees (Fagan 1984). A fungal pathogen, *Colletotrichum gloeosporioides* (Penzig) was identified from the petals, styles and young fruit of limes and oranges (McMillan et al. 1994). Three forms of *Colletotrichum* are now recognized on citrus and include a slow-growing orange form, *C. acutatum* J. H. Simmonds, that has been identified as the causal organism for postbloom fruit drop disease (Brown et al. 1996). Because thrips are abundant in citrus flowers in Florida, a series of experiments were initiated in 1987 to identify their possible involvement with premature flower or fruit drop.

Thirteen species of thrips were collected from citrus flowers or bud samples from over 80 citrus grove sites throughout central, eastern, southeastern and southwestern citrus growing areas in Florida between 1986 and 1991 (Childers et al. 1990, Childers and Beshear 1992). *Frankliniella bispinosa* (Morgan) was the dominant species accounting for 92% of identified specimens. However, in a second survey in southeastern and south central Florida, 65% of identified thrips were *F. bispinosa* and 34% were *F. kellyae* Sakimura (Childers and Beshear 1992). *Frankliniella bispinosa* occurs throughout Florida, but *F. kellyae* has not been collected north of Vero Beach on the east coast or above Hardee Co. in south central Florida. Adults and larvae of both species have been recovered from navel orange flowers and are considered pests (Childers and Achor 1991, Childers 1992). Feeding injury of *F. bispinosa* results in cellular collapse of floral or bud tissues (Childers and Achor 1991).

Sixteen species of thrips were collected on emergence cages placed beneath and between citrus trees in southwest and central Florida between 1989 and 1992 (Childers et al. 1994). Only four species (*F. bispinosa*, *F. kellyae*, *Scolothrips pallidus* (Beach), and *Leptothrips macroocellatus* Watson) were found in both flower or bud samples and emerging from soil beneath or between the trees. The latter two species are predaceous.

A series of experiments to evaluate the attraction (or collection) of *F. bispinosa* and other thrips species to sticky cards of various colors was conducted between 1988 and 1993 during February through April in several citrus groves. The effects of color on trap capture of *F. bispinosa* are reported elsewhere (Childers and Brecht 1996). Here we provide information on the frequency and distribution of thrips species to better understand the diversity and composition of the thysanopteran fauna within citrus groves in Florida.

Materials and Methods

A white disposable card consisting of a 15.2 by 15.2 cm Mark V Krome Kote 12-point coated paper (Jones Printing Co., Lake Alfred, FL) with an interior demarcated sampling area of 12.8 by 12.8 cm was found to effectively attract *F. bispinosa* adults (Childers and Brecht 1996).

Experiment 1. Two sites in southwestern Florida were sampled in 1990. Individual Mark V cards were stapled onto 5 by 5 cm stakes and placed vertically at 0.5, 2.0, and 3.5 m heights in a navel orange grove (Duda site) near Felda, Hendry Co. and at 2.0 m heights in a navel orange grove (Turner site) near Immokalee, Lee Co. Each of six replicates per site was randomly assigned over 20 and 8 ha blocks, respectively, as part of other experiments. Two poles were placed in the center of each untreated block (replicate) of about 0.4 ha and spaced one tree apart within the center row to minimize contact by mowers or applicators. A set of two sticky cards per height on one pole was placed facing north-south and on the second pole facing east-west. There

was a total of 72 cards (= 6 replicates $\times$ 4 directions $\times$ 3 heights) at the Duda site and 24 cards (= 6 replicates $\times$ 4 directions $\times$ 1 height) at the Turner site.

Tangle-trap[®] adhesive (Tanglefoot Co., Grand Rapids, MI) was applied in a thin, uniform layer over the surface of each card with a putty knife. Each card was identified by site, block number, date set, direction and height. Cards were exposed in the field for either 72 (Monday through Thursday) or 96 h (Thursday through Monday). Coated cards were then removed, placed on Plexiglas sheets, sticky sides up, enclosed within wooden boxes and returned to the laboratory for processing. All thrips were counted from each height and direction per sample date. Thrips were carefully removed from each card using 5 $\times$ 0 sable brushes dipped in kerosene. Additional gentle brushing of individual specimens submerged in kerosene removed remnants of adhesive before transferring each thrips to a sample vial containing 80% ethanol. Subsamples of about 100 clear to yellow-colored thrips, collected randomly from the sample vials per sample date, were slide-mounted in Hoyer's medium (Krantz 1978), as were all different colored or patterned thrips, and identified to species.

Experiment 2. In 1991, two navel orange sites in central Florida were selected: Raley, an 8 ha grove in Winter Haven, Polk Co. and Chain-O-Lakes, a 10 ha grove near Holopaw, Osceola Co. Mark V cards were stapled onto 15 by 15-cm plywood plates on 5 by 5-cm stakes and set at 2.0 and 3.5 m heights. Each of five replicates per site was randomly assigned over each grove. Two poles were placed in the center of each untreated block of about 0.4 ha and spaced one tree apart within the row as above. Cards were collected and brought to the laboratory as above.

Frankliniella bispinosa, *F. kelliae* and *F. cephalica* (Crawford) adults are clear to yellowish terebrantians. Therefore, thrips collected in 1991 and subsequent experiments were sorted based on color and size under a stereomicroscope at 8 to 40 $\times$ into two groups (i.e., *Frankliniella* spp. and "other" thrips) and their numbers recorded separately. Subsamples of 20 to 40 clear to yellow-colored thrips, collected randomly from the sample vials, were slide-mounted in Hoyer's medium, as were all different colored or patterned thrips, and identified to species.

Experiment 3. In 1992, Mark V cards were set vertically at 0.5, 2.0, and 3.5 m heights at the Duda navel orange grove near Felda and replicated six times. Two poles were erected in the center of each untreated replicate and spaced one tree apart within the center row. The 0.4-ha plots were selected at random across the 20+-ha block of trees. Placement and exposure times of sticky cards on poles and card collection were as above. Thrips were counted on each card the following day. Subsamples of 20 to 60 specimens of *Frankliniella* spp. and specimens of all "other" thrips per sample date were slide-mounted in Hoyer's medium and identified to species.

Experiment 4. Seventeen colors or hues including Mark V white were selected for comparison in their attraction to *F. bispinosa* during flowering of navel orange in March and April of 1993. Card colors or hues included: blue (O-B), yellow (O-Y) and white (O-W) Olson cards (Olson Products, Inc., Medina, OH); yellow paper file folder (SH-Y) (Smead Mfg. Co., Hastings, MN); blue plastic file folder (DT-B) (Duo-Tang, Inc., Paw Paw, MI); red (PF-R), yellow (PF-Y) and blue plastic (PF-B) Oxford file folders (Esselte, Garden City, NJ); Chromolux violet C65 (C-V), Chromolux blue C64 (C-B), Chromolux pale blue C61 (C-PB), Chromolux metallic blue pearl M64 (CM-BP), Chromolux metallic blue M84 (CM-B), Chromolux marigold C25 (C-M), Chromolux yellow C22 (C-Y) and Chromolux metallic mother-of-pearl M05 (CM-MOP) (Zellerbach, Miamisberg, OH). The Chromolux series of cards were in 11-point paper with

a lacquer based pigment. Color measurements were made with a HunterLab ColorQuest spectrophotometer (Hunter Associates Laboratory, Reston, VA) and were reported by Childers and Brecht (1996).

The colored cards were divided into two series. Series one cards tested the Olson, Oxford, Smead or Duo-tang hues and Krome Kote white and series two cards tested the Chromolux colors and hues and Krome Kote white. Series one cards were evaluated in three experiments in a mature navel orange grove in Winter Haven, Polk Co., FL, and two tests were conducted in a mature navel orange grove south of LaBelle in Hendry Co. Series two cards were evaluated in two experiments in Polk Co. and one in Hendry Co. at the same grove sites. All experiments were in randomized block designs, and each treatment was replicated five times.

Each color or hue treatment was a 15 × 15-cm disposable card, positioned facing east and stapled onto a plywood backing set at 2.0 m above ground on a 5 × 5-cm wooden stake. Cards were coated with Tangle-Trap adhesive and maintained in the field for 72 h. Individual cards were spaced about 17 m apart within a row and 164 m (20 rows) apart in parallel rows in the grove (Hendry Co.). At the Polk Co. site, individual cards were positioned facing east and spaced about 18.3 m apart within a row and 53.4 m (7 rows) apart in parallel rows. A total of three tree rows contained the five replicates at both sites. Card placement in each experiment was completely re-randomized. Subsamples of 20 to 40 *Frankliniella* spp. specimens per treatment in each experiment at the Raley and Duda sites were collected at random for slide-mounting and identification to species. Over 60 *Frankliniella* spp. specimens were subsampled per treatment from both the 16 and 19 April dates in Duda, slide-mounted and identified to species. All "other" thrips were slide-mounted and identified to species. Frequencies of the different species were based on relative numbers of each identified specimen compared with the total number of thrips specimens identified to species.

Results

Experiment 1. Forty-one and 46 species of thrips, respectively, were identified from 667 and 1,016 slide-mounted thrips collected from Mark V white sticky cards at the Turner and Duda sites during 1990 (Table 1). The two sites are about 18 to 20 km apart in southwestern Florida. A total of 60 species were collected from Mark V cards in the two citrus grove sites during the bloom period between 9 February and 2 May. Only 19 species were collected from both locations. *Frankliniella bispinosa* was the prevalent species in both grove sites and accounted for 82 and 79% of the slide-mounted specimens identified from Turner and Duda, respectively. Other less commonly collected species were: *Hoplandrothrips raptor* (Crawford), with 1 and 4%, respectively, *Leptothrips macroocellatus* Watson with 1% at both sites, and *Arorathrips spiniceps* (Hood) with 4 and 3%, respectively. Members of *Hoplandrothrips* are considered to be primarily fungal feeders (Mound and Marullo 1996) while *Leptothrips* species are recognized as predators (zur Strassen 1995), and *Arorathrips* species develop primarily in grass flowers (Palmer et al. 1989). The three species also were collected from emergence cages placed beneath and between citrus trees between 1989 and 1992 (Childers et al. 1994). However, none of the three species have been recovered from citrus flowers to date (Childers et al. 1990, Childers and Beshear 1992).

Table 1. Thrips species collected from Mark V white sticky cards in navel orange groves in southwest Florida from 9 February to 2 May 1990

Species	Turner Immokalee vicinity, Lee County		Duda Felda vicinity, Hendry County		Total	
	No.	(%)*	No.	(%)*	No.	(%)*
Terebrantia						
Heterothripidae						
<i>Heterothrips</i> sp.	2		0		2	
Merothripidae						
<i>Merothrips floridensis</i> Watson	0		1		1	
Thripidae						
<i>Anaphothrips</i> sp.	1		3		4	
<i>Arorathrips spiniceps</i> (Hood)	24	(4%)	28	(3%)	52	(<3%)
<i>Bregmatothrips venustus</i> Hood	0		4		4	
<i>Caliothrips fasciapennis</i> (Hinds)	2		0		2	
<i>Chirothrips crassus</i> Hinds	1		1		2	
<i>Frankliniella bispinosa</i> (Morgan)	549	(82%)	805	(79%)	1,354	(80%)
<i>Frankliniella cephalica</i> (Crawford)	0		1		1	
<i>Frankliniella fusca</i> (Hinds)	0		1		1	
<i>Frankliniella kelliae</i> Sakimura	0		3		3	
<i>Frankliniella occidentalis</i> (Pergande)	1		1		2	
<i>Frankliniella</i> sp.	0		1		1	
<i>Hercinothrips femoralis</i> (Reuter)	1		0		1	
<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)	5		11	(1%)	16	(1%)
<i>Neohydatothrips floridanus</i> (Watson)	2		1		3	
<i>Neohydatothrips</i> sp.	1		1		2	
<i>Scirtothrips</i> sp.	0		4		4	
<i>Scolothrips pallidus</i> (Beach)	2		0		2	
<i>Scolothrips sexmaculatus</i> (Pergande)	0		1		1	
<i>Thrips australis</i> (Bagnall)	0		1		1	
Tubulifera						
Phlaeothripidae						
<i>Adraneothrips pallidus</i> (Watson)	3		13	(1%)	16	(1%)
<i>Antillothrips cingulatus</i> (Hood)	0		1		1	
<i>Cryptothrips</i> sp.	0		1		1	

Table 1. Continued.

Species	Turner Immokalee vicinity, Lee County		Duda Felda vicinity, Hendry County		Total	
	No.	(%)*	No.	(%)*	No.	(%)*
<i>Diceratothrips bicornis</i> Bagnall	0		1		1	
<i>Diceratothrips harti</i> Hood	1		0		1	
<i>Diceratothrips</i> sp.	1		0		1	
<i>Eurythrips ampliventris</i> Hinds	1		1		2	
<i>Eurythrips modestus</i> (Bagnall)	1		0		1	
<i>Eurythrips</i> sp.	0		1		1	
<i>Gastrothrips callipus</i> Hood	17	(3%)	14	(1%)	31	(3%)
<i>Gynaikothrips ficorum</i> (Marchal)	1		0		1	
<i>Haplothrips gowdeyi</i> (Franklin)	1		1		2	
<i>Haplothrips</i> sp. near <i>graminis</i> Hood	1		0		1	
<i>Haplothrips graminis</i> Hood	1		13	(1%)	14	(1%)
<i>Hoplandrothrips jennei</i> (Jones)	5		6		11	(1%)
<i>Hoplandrothrips microps</i> (Hood)	2		1		3	
<i>Hoplandrothrips raptor</i> (Crawford)	8	(1%)	37	(4%)	45	(4%)
<i>Hoplandrothrips</i> sp.	1		3		4	
<i>Hoplothrips brunneri</i> (Watson)	2		1		3	
<i>Hoplothrips</i> sp. (n. sp.)	1		1		2	
<i>Hoplothrips</i> sp.	1		0		1	
<i>Karnyothrips americanus</i> (Hood)	1		0		1	
<i>Karnyothrips flavipes</i> (Jones)	1		3		4	
<i>Karnyothrips harti</i> (Hood)	1		0		1	
<i>Karnyothrips melaleucus</i> (Bagnall)	0		4		4	
<i>Karnyothrips</i> sp.	2		1		3	
<i>Leptothrips cassiae</i> Watson	4		10	(1%)	14	(1%)
<i>Leptothrips macroocellatus</i> Watson	9	(1%)	9	(1%)	18	(2%)
<i>Leptothrips pini</i> (Watson)	1		1		2	
<i>Leptothrips singularis</i> Hood	0		1		1	
<i>Leptothrips</i> sp.	0		2		2	
<i>Macrophthalthothrips</i> sp.	0		1		1	
<i>Malacothrips</i> sp. prob. <i>zonatus</i> Hinds	1		2		3	

Table 1. Continued.

Species	Turner Immokalee vicinity, Lee County		Duda Felda vicinity, Hendry County		Total	
	No.	(%)*	No.	(%)*	No.	(%)*
<i>Malacothrips</i> sp.	0		2		2	
<i>Nesothrips lativentris</i> (Karny)	1		6		7	
<i>Neurothrips magnafemoralis</i> (Hinds)	5		9	(1%)	14	(1%)
<i>Sporothrips amplus</i> (Hood)	1		0		1	
<i>Zaliothrips</i> sp. (n. sp.)	0		2		2	
Idolothripinae sp.	1		0		1	
TOTALS	667		1,016		1,683	

* Not given if % < 1.

Experiment 2. Twenty-two and 13 species of thrips, respectively, were identified from 942 and 582 slide-mounted thrips collected from Mark V white sticky cards at the Raley and Chain-O-Lakes sites, respectively, during 1991 (Table 2). The two sites are about 68 km apart. A total of 29 thrips species were collected in the two sites during the bloom period between 4 February and 25 April, of which only 6 species were common to both locations. Nine of the species collected from central Florida in 1991 were not collected from southwestern Florida during 1990 while 34 species collected from the southwestern sites were not collected in central Florida the following year.

Frankliniella bispinosa was the prevalent species in both grove sites in Polk and Osceola counties and accounted for 91 and 96%, respectively, of the thrips specimens identified. However, the sorted *Frankliniella* spp. specimens accounted for 99.7% of the 150,377 thrips specimens collected from all sticky cards at these locations. One specimen each of *Scolothrips pallidus* (Beach), *Ethirothrips brevis* (Bagnall) and *F. schultzei* (Trybom) were identified from the 855 slide-mounted specimens subsampled as *Frankliniella* spp. All of the identified slide-mounted *Frankliniella* spp. specimens from the Chain-O-Lakes site were *F. bispinosa* and accounted for 99.8% (93,470) of the thrips compared with only 0.2% (113) of "other" thrips.

The next most commonly collected species were *Arorathrips spiniceps* with 4 and less than 1% from Raley and Chain-O-Lakes, respectively, and *Microcephalothrips abdominalis* with 2 and 1%, respectively. *Microcephalothrips abdominalis* is commonly found in flowers of Compositae (Palmer et al. 1989) and has been recovered from emergence cages beneath and between citrus trees during bloom between 1989 and 1992 but not from citrus flowers (Childers et al. 1990, Childers and Beshear 1992, Childers et al. 1994).

Experiment 3. *Frankliniella bispinosa* accounted for 95% of the identified *Frankliniella* spp. at the Duda site during 1992. The remaining 5% consisted of *F. kelliae*, *F. insularis* and *F. fusca*. Eighteen species of thrips were identified from 794 slide-

Table 2. Thrips species collected from Mark V white sticky cards in naval orange groves in central Florida from 4 February to 25 April 1991.

Species	Raley Winter Haven, Polk County		Chain-O-Lakes near Holopaw, Osceola County		Total	
	No.	(%)*	No.	(%)*	No.	(%)*
Thysanoptera						
Terebrantia						
Aeolothripidae						
<i>Stomatothrips</i> sp.	5		3		8	
Thripidae						
<i>Arorathrips mexicanus</i> (Crawford, D. L.)	1		0		1	
<i>Arorathrips spiniceps</i> (Hood)	36	(4%)	1		37	(2%)
<i>Bregmatothrips</i> sp.	1		0		1	
<i>Chirothrips crassus</i> Hinds	0		1		1	
<i>Frankliniella bispinosa</i> (Morgan)	852	(91%)	558	(96%)	1,410	(93%)
<i>Frankliniella fusca</i> (Hinds)	2		0		2	
<i>Frankliniella schultzei</i> (Trybom)	1		0		1	
<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)	15	(2%)	7	(1%)	21	(1%)
<i>Neohydatothrips floridanus</i> (Watson)	0		2		2	
<i>Neohydatothrips</i> sp.	2		0		2	
<i>Plesiothrips perplexus</i> (Beach)	0		1		1	
<i>Scolothrips pallidus</i> (Beach)	1		0		1	
<i>Thrips hawaiiensis</i> (Morgan)	1		0		1	
Tubulifera						
Phlaeothripidae						
<i>Aleurodothrips fasciapennis</i> (Franklin)	0		3		3	
<i>Ethirothrips brevis</i> (Bagnall)	1		0		1	
<i>Gastrothrips callipus</i> Hood	1		1		2	
<i>Haplothrips gowdeyi</i> (Franklin)	2		0		2	
<i>Haplothrips graminis</i> Hood	2		0		2	
<i>Hoplandrothrips marginalis</i> (Hood and Williams)	3		0		3	
<i>Hoplandrothrips raptor</i> (Crawford)	0		2		2	
<i>Hoplandrothrips</i> sp.	0		1		1	
<i>Hoplothrips marginalis</i> (Hood)	6	(1%)	0		6	

Table 2. Continued.

Species	Raley Winter Haven, Polk County		Chain-O-Lakes near Holopaw, Osceola County		Total	
	No.	(%)*	No.	(%)*	No.	(%)*
<i>Karnyothrips melaleucus</i> (Bagnall)	2		0		2	
<i>Leptothrips cassiae</i> Watson	0		1		1	
<i>Leptothrips macroocellatus</i> Watson	1		0		1	
<i>Malacothrips zonatus</i> Hinds	2		0		2	
<i>Neurothrips magnafemoralis</i> (Hinds)	4		1		5	
Idolothripinae	1		0		1	
TOTALS	942		582		1,524	

* Not given if % < 1.

mounted specimens collected between 20 February and 14 April on Mark V Krome Kote white sticky cards at the Duda site during 1992 (Table 3). Three species were collected for the first time since initiating these studies: *F. insularis* (Franklin), *Plesiiothrips perplexus* (Beach) and *Thrips orientalis* (Bagnall). *Frankliniella bispinosa* was the prevalent species collected from the sticky cards and accounted for 76% of the slide-mounted specimens. Other less abundant species were *F. insularis* that accounted for 10% of the identified thrips followed by *F. kelliae* with 4% and *M. abdominalis* with 3%.

Frankliniella bispinosa, *F. insularis*, *F. kelliae*, and *T. orientalis* have been collected from citrus flowers in Florida (Childers and Beshear 1992). Results of trap heights and directions and thrips catch will be reported in a separate paper.

Experiment 4. *Frankliniella bispinosa* accounted for the vast majority of thrips collected in all traps during studies at both the Raley and Duda sites during 1993. In series one cards, adult *Frankliniella* spp. consisted of 4,655 specimens on 19 March, 6,952 on 22 March and 11,619 on 26 March compared with 7, 29 and 25 specimens of "other" thrips, respectively. Series one cards at Duda had *Frankliniella* spp. counts of 845 and 2,444 specimens for 2 and 19 April, respectively. In contrast, only 27 and 7 specimens of "other" thrips, respectively, were collected on the same dates at this site.

Adult *Frankliniella* spp. counts were 2,908 specimens on 6 April and 5,151 specimens on 9 April at Raley and 3,850 specimens from Duda on 16 April compared with 8, 11 and 6 specimens of "other" thrips, respectively, for the series two cards.

The spectral reflectance data were published for each of these cards and *F. bispinosa* trap catches for each card color or hue were compared. Mark V white, Chromolux blue and Duo-Tang blue cards provided comparable trap catches of *F. bispinosa* in those experiments (Childers and Brecht 1996). Insufficient numerical counts were obtained for the remaining thrips species to allow for appropriate statistical analysis (Tables 4 and 5). A color preference for the white Mark V trap was indicated when 69% of *F. kelliae* were collected compared with 23% for the (SH-Y) yellow and 8% for the (DT-B) blue colors. While there were no patterns of attraction

Table 3 Thrips species collected from Mark V white sticky cards located in a navel orange grove at Duda, Felda Vicinity, Hendry, FL, 1992

Species	Total	
	No.	(%)*
Thysanoptera		
Terebrantia		
Aeolothripidae		
<i>Aeolothrips fasciatus</i> (L.)	1	
Heterothripidae		
<i>Heterothrips</i> sp.	4	
Thripidae		
<i>Arorathrips spiniceps</i> (Hood)	12	(2%)
<i>Arorathrips</i> sp. (n. sp.)	1	
<i>Caliothrips fasciapennis</i> (Hinds)	1	
<i>Chirothrips</i> sp.	1	
<i>Frankliniella bispinosa</i> (Morgan)	601	(76%)
<i>Frankliniella fusca</i> (Hinds)	2	
<i>Frankliniella insularis</i> (Franklin)	76	(10%)
<i>Frankliniella kelliae</i> Sakimura	33	(4%)
<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)	21	(3%)
<i>Neohydatothrips floridanus</i> (Watson)	4	
<i>Neohydatothrips</i> sp.	1	
<i>Plesiothrips perplexus</i> (Beach)	1	
<i>Plesiothrips</i> sp.	1	
<i>Scolothrips pallidus</i> (Beach)	1	
<i>Thrips orientalis</i> (Bagnall)	1	
Tubulifera		
Phlaeothripidae		
<i>Adraneothrips pallidus</i> (Watson)	32	(4%)
	794	

* Not given if % < 1.

by the other thrips species, the data are presented to document the positive color attractions.

Six species, *Macrophthalthothrips argus* (Karny), *Plectrothrips antennatus* Hood, *Pseudothrips inequalis* (Beach), *Stomatothrips crawfordi* Stannard, *Taeniothrips eu-*

Table 4. Thrips species (by sex) from sticky cards of different colors or hues held in navel orange groves for 72 h intervals at two locations during 1993 (Series One)

Location and date	Thysanopteran species	Trap color or hue*									
		O-B	O-Y	O-W	SH-Y	DT-B	PF-R	PF-Y	PF-B	K-W	
Raley	Thripidae										
Winter Haven, Polk Co. 19 March	<i>Arorathrips spiniceps</i> (Hood)					1 ♀	1 ♀			1 ♀	
	<i>Frankliniella bispinosa</i> (Morgan)	35 ♀, 3 ♂	36 ♀, 2 ♂	39 ♀, 1 ♂	40 ♀, 1 ♂	40 ♀	39 ♀, 1 ♂	38 ♀, 1 ♂	39 ♀, 1 ♂	38 ♀, 2 ♂	
	<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)				1 ♀		1 ♀				
	<i>Pseudothrips inequalis</i> (Beach)	1 ♀							1 ♀		
	Aeolothripidae										
Raley	<i>Stomatothrips crawfordi</i> Stannard				1 ♀				2 ♀		
22 March	Thripidae										
	<i>Arorathrips spiniceps</i> (Hood)				1 ♀		1 ♀		2 ♀	1 ♀	
	<i>Frankliniella bispinosa</i> (Morgan)	40 ♀	39 ♀, 1 ♂	38 ♀, 3 ♂	40 ♀	40 ♀	27 ♀, 1 ♂	40 ♀	40 ♀	40 ♀, 1 ♂	
	<i>Frankliniella insularis</i> (Franklin)										
	<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)				1 ♀			1 ♀	2 ♀	1 ♀	
	<i>Scirtothrips</i> sp.										
	<i>Taeniothrips eucharis</i> (Whetzel)					1 ♀				1 ♀	
	<i>Thrips hawaiiensis</i> (Morgan)	1 ♀									
	<i>Thrips palmi</i> Karny									1 ♀	

Table 4. Continued.

Location and date	Thysanopteran species	Trap color or hue*									
		O-B	O-Y	O-W	SH-Y	DT-B	PF-R	PF-Y	PF-B	K-W	
Raley 26 March	Phlaeothripidae										
	<i>Aleurodothrips fasciapennis</i> (Franklin)						1 ♂			1 ♀	
	<i>Eurythrips ampliventris</i> Hinds									1 ♀	
	<i>Haplothrips graminis</i> Hood							1 ♀		1 ♀	
	<i>Hoplandrothrips jennei</i> (Jones)										
	<i>Hoplothrips marginalis</i> (Hood)	1 ♀									
	<i>Plectrothrips antennatus</i> Hood	1 ♀									
	Aeolothripidae										
	<i>Stomatothrips crawfordi</i> Stannard					1 ♀					
	Thripidae										
	<i>Arorathrips spiniceps</i> (Hood)						1 ♀				
	<i>Frankliniella bispinosa</i> (Morgan)	19 ♀	21 ♀, 6 ♂	27 ♀, 3 ♂	40 ♀	40 ♀	19 ♀, 1 ♂	36 ♀	57 ♀	20 ♀	
	<i>Frankliniella insularis</i> (Franklin)				1 ♀	1 ♀	2 ♀		2 ♀	2 ♀	
	<i>Frankliniella schultzei</i> (Trybom)	1 ♀									
	<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)				1 ♀		1 ♀		1 ♀		
Phlaeothripidae											
<i>Aleurodothrips fasciapennis</i> (Franklin)									1 ♀		
<i>Diceratothrips</i> sp.	1**					1**					

Table 4. Continued.

Location and date	Thysanopteran species	Trap color or hue*									
		O-B	O-Y	O-W	SH-Y	DT-B	PF-R	PF-Y	PF-B	K-W	
	<i>Elaphrothrips</i> sp.					1 ♀	2 ♀			1 ♀	
	<i>Haplothrips gowdeyi</i> (Franklin)										
	<i>Hoplandrothrips microps</i> (Hood)									1 ♀	
	<i>Leptothrips macroocellatus</i> Watson							1 ♀			
	<i>Macrophthalmothrips argus</i> (Karny)									1 ♀	
	<i>Macrophthalmothrips</i> sp.					1 ♀					
Duda	Thripidae										
Felda vicinity, Hendry Co.	<i>Frankliniella bispinosa</i> (Morgan)	39 ♀, 11 ♂	19 ♀, 3 ♂	19 ♀, 3 ♂	30 ♀, 1 ♂	70 ♀, 9 ♂	5 ♀	15 ♀	56 ♀, 3 ♂	54 ♀, 10 ♂	
2 April	<i>Frankliniella cephalica</i> (Crawford)								1 ♀		
	<i>Frankliniella insularis</i> (Franklin)	1 ♀									
	<i>Frankliniella kelliae</i> Sakimura				1 ♀	1 ♀				1 ♀, 1 ♂	
	<i>Plesiothrips perplexus</i> (Beach)				1 ♀						
	Phlaeothripidae										
	<i>Adraneothrips</i> sp.								1 ♀		
	<i>Adraneothrips pallidus</i> (Watson)							1 ♀			
	<i>Aleurodothrips fasciapennis</i> (Franklin)	1 ♀	1 ♀	1 ♀		1 ♀	3 ♀	2 ♀		1 ♀	
	<i>Eurythrips</i> sp.	1 ♂									
		1**									

Table 4. Continued.

Location and date	Thysanopteran species	Trap color or hue*									
		O-B	O-Y	O-W	SH-Y	DT-B	PF-R	PF-Y	PF-B	K-W	
	<i>Haplothrips gowdeyi</i> (Franklin)	1 ♀									
	<i>Haplothrips</i> sp.						1 ♀				
	<i>Leptothrips cassiae</i> Watson							1 ♂			
	<i>Neohydatothrips</i> sp. near <i>floridanus</i> (Watson)				1 ♀						
	<i>Nesothrips lativentris</i> (Karny)						2 ♀				
	<i>Neurothrips magnafemorialis</i> (Hinds)				1 ♀						
Duda	Thripidae										
19 April	<i>Frankliniella bispinosa</i> (Morgan)	44	18	20	60	56	7	22	47	63	
	<i>Frankliniella kellyae</i> Sakimura				1 ♀, 1 ♂					3 ♀	

* O-B = Olson, blue; O-Y = Olson, yellow; O-W = Olson, white; SH-Y = Smead, yellow; DT-B = Duo-Tang, blue; PF-R = Esselte, red; PF-Y = Esselte, yellow; PF-B = Esselte, blue; K-W = Krome Kote, white.
** Specimen in poor condition.

Table 5. Thrips species (by sex) from sticky cards of different colors or hues held in navel orange groves for 72 h intervals at two locations during 1993 (Series Two)

Location and date	Thysanopteran species	Trap color or hue*									
		C-V	C-B	C-PB	CM-PB	CM-B	C-M	C-Y	CM-MOP	K-W	
Raley Winter Haven, Polk Co. 6 April	Aeolothripidae										
	<i>Stomatothrips crawfordi</i> Stannard									1 ♀	
	Thripidae										
	<i>Frankliniella bispinosa</i> (Morgan)	29 ♀, 1 ♂	19 ♀, 1 ♂	20 ♀	19 ♀	16 ♀, 4 ♂	17 ♀, 1 ♂	17 ♀, 3 ♂	18 ♀, 2 ♂	20 ♀	
	<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)						1 ♀				
	Phlaeothripidae										
	<i>Gastrothrips callipus</i> Hood								1 ♀		
	<i>Haplothrips gowdeyi</i> (Franklin)			1 ♀							
	<i>Hoplandrothrips</i> sp.							1**			
	<i>Leptothrips</i> sp.										
Raley 9 April	<i>Plectrothrips antennatus</i> Hood					1 ♀			1 ♀		
	<i>Plesiothrips perplexus</i> (Beach)										
	Thripidae										
	<i>Frankliniella bispinosa</i> (Morgan)	24 ♀	20 ♀	40 ♀	29 ♀	10 ♀, 2 ♂	16 ♀, 1 ♂	13 ♀	8 ♀	36 ♀	
	<i>Frankliniella insularis</i> (Franklin)					1 ♀	1 ♀				
	<i>Neohydatothrips floridanus</i> (Watson)					1 ♀					
	<i>Scirtothrips</i> sp.								1 ♀		

Table 5. Continued.

Location and date	Thysanopteran species	Trap color or hue*									
		C-V	C-B	C-PB	CM-PB	CM-B	C-M	C-Y	CM-MOP	K-W	
	Phlaeothripidae										
	<i>Aleurodothrips fasciapennis</i> (Franklin)								1 ♀		
	<i>Diceratothrips</i> sp.		1**								
	<i>Gastrothrips callipus</i> Hood									1 ♀	
	<i>Leptothrips cassiae</i> Watson						1 ♀				
	<i>Leptothrips</i> sp.						1**				
	<i>Macrophthalmothrips argus</i> (Karny)									2 ♀	
Duda	Thripidae										
Felda vicinity, Hendry Co.	<i>Frankliniella bispinosa</i> (Morgan)	51	53	64	54	21	55	43	40	66	
16 April	<i>Frankliniella cephalica</i> (Crawford)						1 ♀				
	<i>Frankliniella kelliae</i> Sakimura									3 ♀, 1 ♂	

* C-V = Chromolux violet; C-B = Chromolux blue; C-PB = Chromolux metallic blue pearl; CM-B = Chromolux metallic blue; C-M = Chromolux marigold; C-Y = Chromolux yellow; CM-MOP = Chromolux metallic mother-of-pearl; K-W = Krome Kate, white.
** Specimen in poor condition.

Table 6. Summary of thrips species collected from various sticky cards during and immediately following bloom in navel orange groves (February through May) between 1990 and 1993 in central and southwest Florida

Species	Central Florida		Southwest Florida	Feeding behavior	Reference
	Raley, Winter Haven Polk County and Chain-O-Lakes, near Holopaw, Osceola Co.	Duda, Felda vicinity, Hendry County and Turner, Immokalee vicinity, Lee Co.			
Terebrantia					
Aeolothripidae					
<i>Aeolothrips fasciatus</i> (L.)			X	Predaceous	Lewis 1973
<i>Stomatothrips crawfordi</i> Stannard	X		X	Predaceous	Stannard 1968
<i>Stomatothrips</i> sp.	X			Predaceous	Stannard 1968
Heterothripidae					
<i>Heterothrips</i> sp.			X	Phytophagous	Palmer et al. 1989
Merothripidae					
<i>Merothrips floridensis</i> Watson			X	Fungivorous	Stannard 1968
Thripidae					
<i>Anaphothrips</i> sp. (n. sp.)			X	Phytophagous (Graminae)	Palmer et al. 1989
<i>Arorathrips mexicanus</i> (Crawford, D. L.)	X			Phytophagous (Graminae)	Palmer et al. 1989
<i>Arorathrips spiniceps</i> (Hood)			X	Phytophagous (Graminae)	Palmer et al. 1989
<i>Arorathrips</i> sp. (n. sp.)			X	Phytophagous (Graminae)	Palmer et al. 1989
<i>Bregmatothrips venustus</i> Hood			X	Phytophagous (Graminae)	Stannard 1968
<i>Bregmatothrips</i> sp. (n. sp.)		X		Phytophagous (Graminae)	Stannard 1968
<i>Caliothrips fasciapennis</i> (Hinds)			X	Phytophagous (Graminae)	Wilson 1975
<i>Chirothrips crassus</i> Hinds	X		X	Phytophagous (Graminae)	Palmer et al. 1989

Table 6. Continued.

Species	Central Florida		Southwest Florida		Feeding behavior	Reference
	Raley, Winter Haven Polk County and Chain-O-Lakes, near Holopaw, Osceola Co.	Duda, Felda vicinity, Hendry County and Turner, Immokalee vicinity, Lee Co.				
<i>Chirothrips</i> sp.			X		Phytophagous (Graminae)	Palmer et al. 1989
<i>Frankliniella bispinosa</i> (Morgan)	X		X		Phytophagous	Childers 1992
<i>Frankliniella cephalica</i> (Crawford)			X		Phytophagous	Palmer et al. 1989
<i>Frankliniella fusca</i> (Hinds)	X		X		Phytophagous	Palmer et al. 1989
<i>Frankliniella insularis</i> (Franklin)	X		X		Phytophagous	Palmer et al. 1989
<i>Frankliniella kelliae</i> Sakimura			X		Phytophagous	Childers 1992
<i>Frankliniella occidentalis</i> (Pergande)	X		X		Phytophagous	Palmer et al. 1989
<i>Frankliniella schultzei</i> (Trybom)	X				Phytophagous	Palmer et al. 1989
<i>Frankliniella</i> sp.			X		Phytophagous	Palmer et al. 1989
<i>Hercinothrips femoralis</i> (Reuter)			X		Phytophagous	Palmer et al. 1989
<i>Microcephalothrips abdominalis</i> (Crawford, D. L.)	X		X		Phytophagous	Palmer et al. 1989
<i>Neohydatothrips floridanus</i> (Watson)	X		X		Phytophagous	Palmer et al. 1989
<i>Neohydatothrips</i> sp. near <i>floridanus</i> (Watson)			X		Phytophagous	—
<i>Neohydatothrips</i> sp.	X		X		Phytophagous	Palmer et al. 1989
<i>Plesiothrips perplexus</i> (Beach)	X		X		Phytophagous (Graminae)	Stannard 1968
<i>Plesiothrips</i> sp.	X		X		Phytophagous (Graminae)	Stannard 1968
<i>Pseudothrips inequalis</i> (Beach)	X		X		Phytophagous	Stannard 1968
<i>Scirtothrips</i> sp.	X		X		Phytophagous	Palmer et al. 1989

Table 6. Continued.

Species	Central Florida		Southwest Florida		Feeding behavior	Reference
	Raley, Winter Haven Polk County and Chain-O-Lakes, near Holopaw, Osceola Co.		Duda, Felda vicinity, Hendry County and Turner, Immokalee vicinity, Lee Co.			
<i>Scolothrips pallidus</i> (Beach)	X		X		Predaceous	Palmer et al. 1989
<i>Scolothrips sexmaculatus</i> (Pergande)			X		Predaceous	Palmer et al. 1989
<i>Taeniothrips eucharis</i> (Whetzel)	X				Phytophagous	Palmer et al. 1989
<i>Thrips australis</i> (Bagnall)			X		Phytophagous	Palmer et al. 1989
<i>Thrips hawaiiensis</i> (Morgan)	X				Phytophagous	Palmer et al. 1989
<i>Thrips orientalis</i> (Bagnall)			X		Phytophagous	Palmer et al. 1989
<i>Thrips palmi</i> Karny	X				Phytophagous	Palmer et al. 1989
Tubulifera						
Phlaeothripidae						
<i>Adraneothrips pallidus</i> (Watson)			X		Fungivorous	Mound and Marullo 1996
<i>Aleurodothrips fasciapennis</i> (Franklin)	X		X		Predaceous	Lewis 1973
<i>Antillothrips cingulatus</i> (Hood)			X		Unknown	Pitkin 1977
<i>Cryptothrips</i> sp.			X		Fungivorous	Mound and Palmer 1983
<i>Diceratothrips bicornis</i> Bagnall			X		Fungivorous-1*	Mound and Palmer 1983
<i>Diceratothrips hart</i> Hood			X		Fungivorous-1*	Mound and Palmer 1983
<i>Diceratothrips</i> sp.	X		X		Fungivorous-1*	Mound and Palmer 1983
<i>Elaphrothrips</i> sp.	X				Fungivorous	Mound and Palmer 1983
<i>Ethirothrips brevis</i> (Bagnall)	X				Fungivorous	Mound 1976
<i>Eurythrips ampliventris</i> Hinds	X		X		Fungivorous	Mound 1976
<i>Eurythrips modestus</i> (Bagnall)			X		Fungivorous	Mound 1976

Table 6. Continued.

Species	Central Florida		Southwest Florida	Feeding behavior	Reference
	Raley, Winter Haven Polk County and Chain-O-Lakes, near Holopaw, Osceola Co.		Duda, Felda vicinity, Hendry County and Turner, Immokalee vicinity, Lee Co.		
<i>Eurythrips</i> sp.			X	Fungivorous	Mound and Palmer 1983
<i>Gastrothrips callipus</i> Hood		X	X	Fungivorous	Mound and Palmer 1983
<i>Gynaikothrips ficorum</i> (Marchal)			X	Phytophagous	Palmer et al. 1989
<i>Haplothrips gowdeyi</i> (Franklin)		X	X	Phytophagous	Palmer et al. 1989
<i>Haplothrips graminis</i> Hood		X	X	Phytophagous (Graminae)	Palmer et al. 1989
<i>Haplothrips</i> sp. near <i>graminis</i>			X	Phytophagous	Palmer et al. 1989
<i>Haplothrips</i> sp.			X	Phytophagous	Palmer et al. 1989
<i>Hoplandrothrips jennei</i> (Jones)		X	X	Fungivorous	Palmer et al. 1989
<i>Hoplandrothrips marginalis</i> (Hood and Williams)		X		Fungivorous	Palmer et al. 1989
<i>Hoplandrothrips microps</i> (Hood)		X	X	Fungivorous	Palmer et al. 1989
<i>Hoplandrothrips raptor</i> (Crawford)		X	X	Fungivorous	Palmer et al. 1989
<i>Hoplandrothrips</i> sp.		X	X	Fungivorous	Palmer et al. 1989
<i>Hoplothrips brunneri</i> (Watson)			X	Fungivorous	Palmer et al. 1989
<i>Hoplothrips marginalis</i> (Hood)				Fungivorous-2*	Palmer et al. 1989
<i>Hoplothrips</i> sp. (n. sp.)		X	X	Fungivorous-2*	Palmer et al. 1989
<i>Hoplothrips</i> sp.			X	Fungivorous-2*	Palmer et al. 1989
<i>Karnyothrips americanus</i> (Hood)			X	Predaceous	Palmer et al. 1989
<i>Karnyothrips flavipes</i> (Jones)			X	Predaceous	Lewis 1973
<i>Karnyothrips hartii</i> (Hood)			X	Predaceous	Lewis 1973

Table 6. Continued.

Species	Central Florida		Southwest Florida		Feeding behavior	Reference
	Raley, Winter Haven Polk County and Chain-O-Lakes, near Holopaw, Osceola Co.		Duda, Felida vicinity, Hendry County and Turner, Immokalee vicinity, Lee Co.			
<i>Karyothrips melaleucus</i> (Bagnall)	X		X		Predaceous	Lewis 1973
<i>Karyothrips</i> sp.			X		Predaceous	Lewis 1973
<i>Leptothrips cassiae</i> Watson	X		X		Predaceous	Palmer et al. 1989
<i>Leptothrips macrocellatus</i> Watson	X		X		Predaceous	Palmer et al. 1989
<i>Leptothrips pini</i> (Watson)			X		Predaceous	Palmer et al. 1989
<i>Leptothrips singularis</i> Hood			X		Predaceous	Palmer et al. 1989
<i>Leptothrips</i> sp.	X		X		Predaceous	Palmer et al. 1989
<i>Macrophthalmothrips argus</i> (Karny)	X		X		Fungivorous	Mound and Marullo 1996
<i>Macrophthalmothrips</i> sp.	X		X		Fungivorous	Mound and Marullo 1996
<i>Malacothrips zonatus</i> Hinds	X		X		Unknown	Stannard 1968
<i>Malacothrips</i> sp. prob. <i>zonatus</i> Hinds			X		Unknown	Stannard 1968
<i>Malacothrips</i> sp.			X		Unknown	Stannard 1968
<i>Nesothrips lativentris</i> (Karny)			X		Fungivorous	Mound and Palmer 1983
<i>Neurothrips magnafemoralis</i> (Hinds)	X		X		Fungivorous	Stannard 1968
<i>Plectrothrips antennatus</i> Hood	X				Fungivorous	Stannard 1968
<i>Sporothrips amplius</i> (Hood)			X		Fungivorous	Stannard 1968
<i>Zaliothrips</i> sp. (n. sp.)			X		Predaceous	Mound and Marullo 1996
<i>Idolothripinae</i> sp.	X		X		Fungivorous	Mound and Palmer 1983

1* associated with fungi, under bark, dead twigs, branches and leaf litter.

2* found under both dead branches and bark.

charii (Whetzel) and *Thrips palmi* Karny, were collected in one or more blue traps or in the Mark V white sticky cards (Table 4). None of these species was collected in earlier experiments with Mark V white sticky cards.

Discussion

Eighty-six species of thrips were identified from colored sticky cards in central and southwest Florida between 1990 and 1993 (Table 6). A total of 46 species of thrips were collected from colored sticky cards in Polk and Osceola counties in central Florida and 75 thrips species in Hendry and Lee counties (Table 6). Only 33 of these species were collected from sticky cards in both central and southwest Florida during 1993.

These experiments elucidate the diversity and composition of thrips fauna in citrus groves in Florida during bloom. Thirty-seven species are phytophagous. Twelve of the phytophagous species feed on plants of the Graminae. *Gynaikothrips ficorum* (Marchal) feeds on *Ficus* and causes leaf galls; 8 species, *Hercinothrips femoralis*, *Heterothrips* sp., *Frankliniella fusca*, *Neohydatothrips floridanus*, N. sp. near *floridanus*, *Neohydatothrips* sp., *Scirtothrips* sp., and *Thrips palmi* feed primarily on foliage although several also infest flowers. Thirteen species feed primarily on floral parts including *F. bispinosa*, *F. cephalica*, *F. insularis*, *F. kelliae*, *F. occidentalis*, *F. schultzei*, *Microcephalothrips abdominalis*, *Pseudothrips inequalis*, *Taeniothrips eucharii*, *Thrips australis*, *T. hawaiiensis*, *T. orientalis*, and *Haplothrips gowdeyi*, although several species such as *F. occidentalis* feed also on foliage. The remaining 4 species including *Frankliniella* sp., *Haplothrips* sp. near *graminis*, *Haplothrips* sp. are believed to be phytophagous.

Seventeen species are known predators or species belonging in genera that include predators, and 28 are fungivorous feeding mainly on fungal spores, hyphae or saprophytic feeding on digested products of fungal decay (Mound and Palmer 1983). The feeding habits of the remaining 4 species, *Antillothrips cingulatus* (Hood), *Malacothrips zonatus* Hinds, M. sp. prob. *zonatus* Hinds, and *Malacothrips* sp., are unknown.

Acknowledgments

The authors wish to thank the following individuals for their constructive comments and suggestions during the preparation of this manuscript: S. E. Webb, P. A. Stansly, J. E. Funderburk and H. N. Nigg. We thank D. Threlkeld, M. G. Warmington, E. White, M. Harvey and P. Keen for technical assistance. Voucher specimens are located at the University of Florida, Citrus Research and Education Center, Lake Alfred, Florida.

Florida Agricultural Experiment Station Journal Series No. R-05431.

References Cited

- Brown, A. E., S. Sreenivasaprasad and L. W. Timmer. 1996.** Molecular characterization of slow-growing orange and key lime anthracnose strains of *Colletotrichum* from citrus as *C. acutatum*. *Phytopath.* 86: 523-527.
- Childers, C. C. 1992.** Suppression of *Frankliniella bispinosa* (Thysanoptera: Thripidae) and the fungal pathogen *Colletotrichum gloeosporioides*, with pesticides during the bloom cycle and improved fruit set on navel orange in Florida. *J. Econ. Entomol.* 85: 1330-1339.
- Childers, C. C. and D. S. Achor. 1991.** Feeding and oviposition injury to navel orange flowers

- and developing floral buds by *Frankliniella bispinosa* (Thysanoptera: Thripidae) in Florida. Ann. Entomol. Soc. Am. 84: 272-282.
- Childers, C. C. and R. J. Beshear. 1992.** Thrips (Thysanoptera) species associated with developing citrus flowers in Florida and a key to adult Terebrantian females. J. Entomol. Sci. 27: 392-412.
- Childers, C. C., R. J. Beshear, J. R. Brushwein and H. A. Denmark. 1990.** Thrips (Thysanoptera) species, their occurrence and seasonal abundance on developing buds and flowers of Florida citrus. J. Entomol. Sci. 25: 601-614.
- Childers, C. C. and J. K. Brecht. 1996.** Colored sticky cards for monitoring *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) during flowering cycles in citrus. J. Econ. Entomol. 89: 1240-1249.
- Childers, C. C., S. Nakahara and R. J. Beshear. 1994.** Relative abundance of *Frankliniella bispinosa* and other species of Thysanoptera emerging from soil beneath navel orange trees in Florida during spring flowering. J. Entomol. Sci. 29: 318-329.
- Fagan, H. J. 1984.** Postbloom fruit drop of citrus in Belize. I. Disease epidemiology. Turrialba 34: 173-177.
- Krantz, G. W. 1978.** A manual of acarology. Second edition. Oregon State Univ. Book Stores, Inc., Corvallis. 509 pp.
- Lewis, T. 1973.** Thrips, their biology, ecology and economic importance. Academic Press, London.
- McMillan, R. T., Jr., L. W. Timmer and R. J. McGovern. 1994.** Postbloom fruit drop. Univ. Florida Coop. Ext. Serv. SP 165.
- Mound, L. A. 1972.** Tropical fungus-feeding Thysanoptera of the genus *Macrophalthothrips*. J. Entomol. 41(1): 77-88.
- 1976.** American leaf-litter Thysanoptera of the genera *Erkosothrips*, *Eurythrips* and *Terthrothrips* (Phlaeothripidae: Phlaeothripinae). Bull. Brit. Mus. (Nat. Hist.) Entomol. 35(2): 27-64.
- Mound, L. A. and R. Marullo. 1996.** The thrips of Central and South America: an introduction (Insecta: Thysanoptera). Mem. Entomol., International. Vol. 6. Associated Publishers. Gainesville, FL.
- Mound, L. A. and J. M. Palmer. 1983.** The generic and tribal classification of spore-feeding Thysanoptera (Phlaeothripidae: Idolothripinae). Bull. Brit. Mus. (Nat. Hist.) Entomol. 46(1): 1-174.
- Palmer, J. M., L. A. Mound and G. J. du Heaume. 1989.** 2. Thysanoptera. CIE Guides to Insects of Importance to Man. CAB International Institute of Entomology. British Museum Natural History.
- Pitkin, B. R. 1977.** The genus *Antillothrips* Stannard, with descriptions of two new species (Thysanoptera: Phlaeothripidae). Syst. Entomol. 2: 55-58.
- Stannard, L. J. 1968.** The thrips, or Thysanoptera, of Illinois. Illinois Nat. Hist. Sur. Bull. 29(4): 215-552.
- Strassen, zur, R. 1995.** Binomial data of some predaceous thrips. Thrips Biology and Management. Parker, B. L., M. Skinner and T. Lewis (eds.) Plenum Press, New York.
- Wilson, T. H. 1975.** A monograph of the subfamily Panchaetothripinae (Thysanoptera: Thripidae). Mem. Am. Entomol. Inst. 23: 1-354.