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STRUCTURE AND COMPOSITION OF A THRIPS COMMUNITY IN THE CHIHUAHUA DESERT, NEW MEXICO, U.S.

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ABSTRACT

We examined plant used versus plant availability by a thysanopteran community on 13 woody and perennial native plants in the Chihuahua Desert. Individual plants were sampled with sticky-traps on 8 dates from May 1997 to August 1998. We sampled 5,040 adult thrips from 26 species in 19 genera, of which 16 could be identified to species. Four families were represented, Thripidae (17 species comprised 98.2 % of the collected specimens), Phlaeothripidae (5 species comprised 1.6%), Aeolothripidae (2 species comprised 0.1%) and Heterothripidae (1 species comprised 0.1%). A total of 16 species (84.2%) were phytophagous on flowers and leaves, 2 (10.5%) were predators, one (5.2%) was mycophagous. Feeding habits for 7 species are unknown. Thrips abundance was positively correlated with plant volume, but not with insect richness. Strikingly for a natural area, *Frankliniella occidentalis* accounted for 73.6% of the total collection of the sampled thrips, which together with *Chirothrips falsus, Microcephalothrips abdominalis, Frankliniella gossypiana,* and *Neohydatothrips signifier,* comprised 94.0% of the total number of collected thrips. Main abundances, considering all thrips species, occurred in fall and spring; no thrips were collected during winter. This seasonal pattern of occurrence was observed for the most abundant thrips species. In summary, the results of this study were: 1) few thrips species were found to be specialists; only 2 thrips species out of 12 studied, showed strong preference for host plants, 2) presence of a high percentage of positive associations, and a low percentage of negative associations, 3) the role of plant volume explained more than 80% of variance of thrips abundance. These results suggest that the studied thrips community has low plant specificity and the pattern of plant use observed could be the consequence of generalist feeding diets.

Key Words: Thysanoptera, insect-plant association, desert plants

RESUMEN

Examinamos el uso de plantas versus la disponibilidad de plantas de una comunidad de Thysanoptera sobre 13 plantas nativas (leñosas y perennes) en el desierto de Chihuahua. Se muestrearon plantas individuales con trampas pegajosas en 8 fechas desde de mayo de 1997 hasta agosto de 1998. Se obtuvieron 5.040 trips adultos pertenecientes a 26 especies en 19 géneros, de los cuales 16 se pudo identificar hasta especie. Cuatro familias están representadas, Thripidae (17 especies que representaron el 98,2% de los especímenes recolectados), Phlaeothripidae (5 especies que constituyeron 1,6%), Aeolothripidae (2 especies que constituyeron el 0,1%) y Heterothripidae (1 especie que correspondió al 0,1%). Un total de 16 especies (84,2%) fueron fitófagos (en flores y hojas), 2 (10,5%) fueron depredadores, uno (5,2%) fue micófago. De 7 especies se desconocen sus hábitos alimentarios. La abundancia de trips se correlacionó positivamente con el volumen de las plantas, no así con la riqueza. Sorprendentemente para un área natural, *Frankliniella occidentalis* representó el 73,6% de la recolección total de los trips, que junto con *Chirothrips falsus*, *Microcephalothrips abdominalis*, *Frankliniella gossypiana*, y *Neohydatothrips signifer*, representaron 94,0% del total recogido. La mayor abundancia de trips se produjo en otoño y primavera, y no se recolectaron trips en el invierno. Este patrón estacional de ocurrencia se observó para las especies de trips más abundante. En resumen, los resultados de este estudio fueron: 1) presencia de pocas especies de trips fueron especialistas, sólo dos especies de trips de los 12, mostraron una clara preferencia por sus plantas hospedantes, 2) presencia de un alto porcentaje de asociaciones positivas, y un bajo porcentaje de asociaciones negativas, 3) el rol del volumen de plantas que explica más del 80% de la varianza de la abundancia de trips. Estos resultados sugieren

que la comunidad trips estudiado tiene una baja especificidad y el patrón de utilización de las plantas es consecuencia de una dieta alimentaria generalista.

The diversity of the Thysanoptera fauna of the United States is partially known, mainly because of the limited studies and collecting efforts in natural areas. So far, 3 states, California, Florida and Georgia, have a checklist of Thysanoptera species (Hoodle et al 2004; Diffie et al. 2008). These authors recognize that the lists are incomplete because of the lack of surveys in many different ecosystems; yet they constitute most of the available information on Thysanoptera fauna related to pest thrips (Lewis 1997; Moritz et al. 2004). Most studies on thrips have been focused on control of the pest species. Consequently, there is a big gap in knowledge of thrips associated with native plants. Owing to the unceasing destruction of natural environments, any information on species diversity has become critically important to understand the functioning of natural communities. Thrips are not currently endangered or threatened, and their survival is based on the conservation of their host plants and habitats (Pinent et al. 2006).

From 1997 to 1998, we carried out a study of the phytophagous insect community in an arid ecosystem located in New Mexico dominated by creosote bush (*Larrea tridentata* (Moç. & Seseé ex DC.) Coville), woody snakeweeds (*Gutierrezia* spp.), honey mesquite (*Prosopis glandulosa* Torrey), and tarbush (*Flourencia cernua* DC.). This paper describes, for the first time, the species composition of a native community of thrips in New Mexico in which thrips species were sampled on 13 perennial woody plants to provide information of plant use, thrips abundance and seasonality.

MATERIAL AND METHODS

Detailed information on the sampling site and methodology used is given in Logarzo et al. (2002). A summary is presented here. The 150 m × 50 m plot was located at the Chihuahua Desert Rangeland Research Center in Doña Ana County, New Mexico, USA. We conducted 8 samplings on 13 shrub, sub-shrub and perennial herb species (Table 1), from Jun 1997 to Aug 1998. We carried out 6 of these samplings on 13 shrub, sub-shrub and perennial herb species (Table 1), from Jun 1997 to Aug 1998 (5 June, 13 September and 11 November 1997; 31 January 21 June and 8 July 1998), at the Chihuahua Desert Rangeland Research Center in Doña Ana County, New Mexico, USA.

Ten transects of 50 m each were randomly located across the plot (150 m × 50 m), 13 points were randomly placed along each transect using a random number table. The 13 plant species were randomly assigned along each transect and subsequently, a trap was placed in the middle of the plant specimen of the assigned species located closest to the point; 130 plant specimens (10 replications for each plant species studied) were randomly selected by this method in each sampling date.

With this method, plants with a random or regular spatial distribution had a higher probability of being selected as opposed to plants growing in patches. At each sampling date, a standard unbaited Biolure red delta prism-shaped sticky trap (Consep Biorational Products for Agriculture, Bend, Oregon), measuring 10 × 18 cm on each of the 3 sides (540 cm² total surface), was placed 1

TABLE 1. LIST OF THE 13 PLANT SPECIES USED IN THE STUDY 1.

Common name	Scientific name	Family[2]	Architecture and Size
Cutleaf brickellbush	*Brickellia laciniata* Gray	As	Shrub, 1-2 m,
Tarbush	*Flourensia cernua* DC.	As	Shrub, 1-2 m
Broom snakeweed	*Gutierrezia sarothrae* Britt& Rusby	As	Woody plants, 0.2-1 m
Threadleaf snakeweed	*Gutierrezia microcephala* (DC.) Gray	As	Woody plants, 0.2-1 m
Blackfoot daisy	*Melampodium leucanthum* Torr. Gray	As	Perennial, 10-30 cm
Mariola	*Parthenium incanum* Kunth	As	Woody perennial, 0.4-1 m
Prickleleaf dogweed	*Thymophylla acerosa* DC.	As	Shrubby perennial, 10-25 cm
Desert zinnia	*Zinnia acerosa* (DC.) Gray	As	Low shrublet, 6-25 cm,
Feather indigobush	*Dalea formosa* Torr.	Fa	Shrub, 0.3-1 m
Honey mesquite	*Prosopis glandulosa* Torr.	Fa	Shrub or tree, up to 4 m
Leatherweed	*Croton pottsii* (Klotzsch) Muell.-Arg.	Eu	Perennial, 20-60 cm
Littleleaf sumac	*Rhus microphylla* Engelm	An	Shrub, 1-3 m
Soap-tree yucca	*Yucca elata* Engelm	Ag	Semi-succulent shrub, up to 5 m
Creosote-bush	*Larrea tridentata* (DC.) Cov.	Zy	Evergreen bush, up to 2 m

[1]Information taken from Allred (1988).

[2]Family: As, Asteraceae, Fa, Fabaceae, Eu, Euphorbiaceae, An, Anacardiaceae, Ag, Agavaceae, Zy, Zygophyllaceae.

per plant sampled. However, in the case of *Croton pottsii* (Klotzsch) Mueller of Aargau, a very small plant that occurs in clumps, a single trap was placed among several plants). Traps were left to collect insects for 6 d, based on a prior pilot study that identified the length of time at which insect numbers collected stabilized. In this study we tested several aspects of the methodology including a yellow sticky trap, and compared the results of the sticky traps with the results obtained with other collecting methods (beating and sweeping); and we selected the delta-prism sticky trap as the best collecting method for the survey. This method was chosen because it was time effective and allowed us to place the traps during one morning with a reduced variance compared to the other collecting methods. On the first and second sampling dates, *Brickellia laciniata* Gray was not sampled and only 5 replications per plant species were made. More detailed information on sampling and methodology is given in Logarzo et al. (2002).

In the laboratory, thrips were easily removed from the trap using a citric acid solution (Goo gone®) then were mounted and identified for MIZ. The world thrips specialist, Dr. L. A. Mound, CSIRO, Australia, confirmed thrips identifications. Insect voucher specimens are located in the entomological collection of the Instituto de Biología de la Altura, Universidad Nacional de Jujuy, Jujuy Province, Argentina, and Dr. L. A. Mound has another set of voucher specimens. Immature thrips were not included in this study due to the difficulty in identifying them.

Statistical Analysis of Insect-Plant Associations

Insect-plant associations were determined for the 12 most abundant thrips species using the Poisson regression (Cameron & Trivedi 1998). Here we did a regression of number of insect captured as a function of the logarithm of plant volume in order to estimate the expected mean number of insects of each species to be captured in each plant. The regression curve only had one parameter, the slope which was also forced to be positive, because the expected number of insects in a plant of zero volume was also zero, and a negative number of insect per plant does not have a biological or a statistical meaning (the parameter of the Poisson distribution is always positive).

The line of regression represented the same case as null hypothesis in the Neu method (Neu et al. 1974), in which it compares the availability of each plant species with the actual proportion used by the plant-feeding insects. Here, plant use means any behavior between thrips and plants beyond feeding, such as mating, predation, or shelter. Critical assumptions are that all the insect observations are independent and that the availability of each plant is the same for all insects. In this study, plant availability was measured as the total volume of each plant species sampled. Our scientific hypothesis was that thrips used plants differentially. Statistically, the null hypothesis tested states that thrips use plants in proportion to plant availability, considering all the plants simultaneously. The Poisson regression is more robust than the Neu method in cases where the number of insects is low and there are zeroes.

After calculating the regression, we tested whether the number of captured insects differed from the expected value by the regression by using the Poisson cumulative distribution (CDF).

Negative Relationships. If the number of captured insects was lower than expected, the probability value was $Pij = Pois(\lambda, x > n_{ij})$, where n_{ij} is the number of insects of species j captured in the plant i, the parameter λ of the Poisson distribution is calculated as $\lambda = v_i s_j$, with v_i as the plant i volume, and s_j the slope of the regression line of the insect j.

Positive Relationships. If the number of captured insects was higher than expected, the P value was calculated as $P_{ij} = 1 - Pois(\lambda, x > nij +1)$. In both cases, we considered the differences to be significant in cases where P_{ij} was less than $0.025/12$.

It should be noted that we did not check the regression significance in this case, because we did not test if the number of thrips per plant was an increasing linear function of the volume of the plant. For example, if the slope were close to 0, it would be used anyway.

The parameter of the regression line was calculated using Markov Chain Montecarlo methodology with Poisson likelihood (Roberts & Casella 2004), and selecting the best fitting value after 1,000,000 simulations. The calculations were performed using the Markov Chain Montecarlo library pymc for the python programming language (Patil et al 2010).

Availability of host plants is difficult to quantify but refers here to the approximate volume of an individual plant, rather than to the total volume of a plant species in the study area. Plant volume was estimated based on specimen's length, width and height, which were measured on each plant after the trap had been placed.

Three linear regression analyses were conducted with data of the 13 studied plant species: 1) between logarithm of the total plant volume and numbers of insects captured on each plant species, 2) between logarithm of plant volume and thrips richness of each plant species, and 3) between thrips captured and richness obtained on each plant species.

RESULTS

Twenty-six species of thrips were identified from 5,040 specimens collected from 13 plant species (Table 2), 4 of 5 thrips families reported in the USA

TABLE 2. THRIPS SPECIES AND NUMBER OF CAPTURES ON EACH PLANT SPECIES WHERE THEY WERE COLLECTED.

Thrips species	Feeding habit	No. collected	Plant Species												
			BL[1]	CP	DF	FC	GS	LT	ML	PI	PG	RM	TA	YE	ZA
Phlaeothripidae															
Haplothrips graminis Hood	Phytophagous?	33	1	2	0	5	4	2	4	1	6	3	3	2	3
Haplothrips malifloris Hood	Phytophagous?	3	0	0	1	0	0	0	1	0	0	1	0	0	1
Hoplothrips sp.	Fungal hyphae	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Leptothrips mali (Fitch)	Predator	47	1	1	2	6	1	8	1	2	6	7	3	8	1
Karnyothrips sp.	Predator?	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Heterothripidae															
Heterothrips propidis Crawford	Phytophagous	5	0	0	0	0	0	1	0	1	2	1	0	0	0
Aeolothripidae															
Aeolothrips sp.	Predator?	4	1	0	0	0	0	0	1	0	1	1	0	0	0
Stomatothrips sp.	Predator?	2	0	0	0	1	0	0	0	0	0	0	1	0	0
Melanthrips sp.	Phytophagous	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Thripidae															
Arorathrips mexicanus (Crawford)	Phytophagous	15	0	0	0	2	1	1	1	0	2	2	0	2	5
Chirothrips falsus Priesner	Phytophagous	199	6	16	28	6	13	23	16	13	20	12	19	14	13
Chirothrips sp.	Phytophagous	10	0	0	1	9	0	0	0	0	0	0	0	0	0
Bregmatothrips venustus Hood	Phytophagous	30	1	2	3	3	4	2	2	2	4	3	1	0	3
Microcephalothrips abdominalis (Crawford)	Phytophagous	168	16	23	13	6	10	8	18	11	6	13	20	9	15
Scolothrips sp.	Predator	4	0	1	0	0	0	0	0	0	0	0	2	1	0
Caliothrips fasciatus Pergande	Phytophagous	7	0	0	1	0	0	1	0	1	1	0	0	2	2
Plesiothrips sp.	Phytophagous	2	0	0	0	0	0	0	0	1	0	0	0	0	0
Frankliniella minuta (Moulton)	Phytophagous	22	1	0	1	1	3	2	1	1	5	2	3	2	0
Frankliniella gossypiana (Hood)	Phytophagous?	261	21	18	21	16	10	12	56	6	16	37	15	25	8
Frankliniella insularis (Franklin)	Phytophagous	6	0	0	2	0	0	1	0	0	0	2	0	1	0
Frankliniella occidentalis (Pergande)	Phytophagous, facultative predator	3708	322	133	153	317	128	354	117	226	822	462	108	451	115
Baileyothrips arizonensis (Morgan)	Phytophagous?	71	8	0	7	4	5	1	17	12	2	2	7	5	1
Neohydatothrips signifer Priesner	Phytophagous	434	270	12	2	20	38	28	4	8	12	14	3	17	6
Neohydatothrips sp #2	Phytophagous	3	0	0	0	0	0	0	0	0	0	0	1	2	0
Neohydatothrips sp #3	Phytophagous	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Kurtomathrips morrilli Moulton	Phytophagous	2	0	0	1	0	0	0	0	0	0	0	0	0	1

[1]BL = *Brickella laciniata*, CP = *Croton pottsii*, FL = *Flourensia cernua*, GS = *Gutierrezia* spp., LT = *Larrea tridentata*, ML = *Melampodium leucanthum*, PI = *Parthenium incanum*, PG = *Prosopis glandulosa*, RM = *Rhus microphylla*, TA = *Thymophylla acerosa*, YE = *Yucca elata*, ZA = *Zinnia acerosa*.
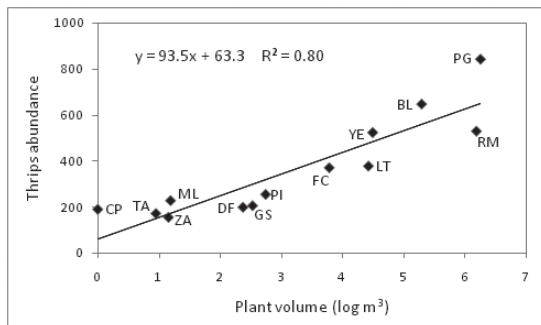
Fig. 1. Effect of plant volume (in logarithm) on thrips abundance on the 13 plant species studied. BL = *Brickella laciniata*, CP = *Croton pottsii*, FL = *Flourensia cernua*, GS = *Gutierrezia* spp, LT = *Larrea tridentata*, ML = *Melampodium leucanthum*, PI = *Parthenium incanum*, PG = *Prosopis glandulosa*, RM = *Rhus microphylla*, TA = *Thymophylla acerosa*, YE = *Yucca elata*, ZA = *Zinnia acerosa*.
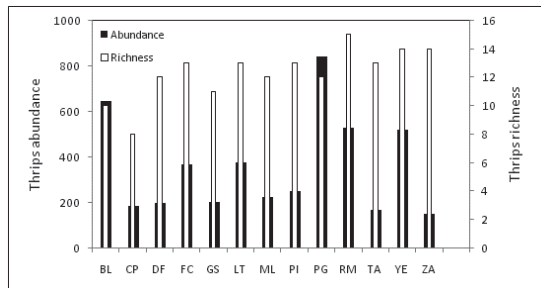

Fig. 2. Relationship between thrips abundance and richness on the 13 plant species studied. BL = *Brickella laciniata*, CP = *Croton pottsii*, FL = *Flourensia cernua*, GS = *Gutierrezia* spp, LT = *Larrea tridentata*, ML = *Melampodium leucanthum*, PI = *Parthenium incanum*, PG = *Prosopis glandulosa*, RM = *Rhus microphylla*, TA = *Thymophylla acerosa*, YE = *Yucca elata*, ZA = *Zinnia acerosa*.

were represented in the findings, most of them, 17 species, belonged to the Thripidae family. The remaining 9 thrips species were in Phlaeothripidae (5 species), Aelothripidae (3), and Heterothripidae (1) (Table 2). Strikingly for a natural area, *Frankliniella occidentalis* (Pergande), a cosmopolitan pest native to Western United States, accounted for 73.6% of the total collection of 5,040 thrips. A total of 16 species (84.2%) were phytophagous (on flowers and leaves), 2 (10.5%) were predators and one (5.2%) was mycophagous. Feeding habits are unknown for 7 species (Table 2). Five species, *F. occidentalis* (3,708 specimens), *Neohydatothrips signifer* Priesner (412), *F. gossypiana* (Hood) (261), *Chirothrips falsus* Priesner (199), *Microcephalothrips abdominalis* Crawford (168), accounted for 94.0% of the total collection (Table 2).

Plant volume accounted for 80% of variance of thrips abundance. We found a relationship between natural logarithm of plant volume (of each species) and thrips total abundance ($F = 43.63$, $gl = 11$, $P = 0.0001$) (Fig. 1). Thrips richness ranged between 8 and 15 species on each of the 13 host plants. *Rhus microphylla Engelm* had the highest number of thrips species (15), followed by *Yucca elata Engelm* (14) and *Zinnia acerosa* (DC.) Gray (14) (Table 2). The average number of thrips species along the 13 host plants was 12.3 (SD= 1.8). We did not find a relationship either between richness and logarithm of plant volume ($F = 1.52$, $gl = 11$, $P = 0.24$), or richness and thrips abundance ($F = 0.08$, $gl = 11$, $P = 0.77$) (Fig. 2).

Of the 156 possible plant-insect pairs (12 thrips species and 13 plant species analyzed), 50.6% (79) demonstrated random use, 22.4% (34) demonstrated negative associations and 26.9% (42) positive aggregation. Although, all analyzed insect species showed at least 1 positive interaction, even the predator *Leptothrips mali* (Fitch), only 2 insect-plants pairs showed strong positive associations with their host plants: 90% of *Chiro-*

thrips sp. specimens were collected on *Flourensia cernua* DC., and 65.5% of *Neohydatothrips signifer* Priesner were collected on *B. laciniata*.

Frankliniella occidentalis was the most abundant thrips, and was collected on the 13 studied plants. It was positively associated to 10 hosts, and negatively associated to *B. laciniata, Prosopis glandulosa Torr.* and *R. microphylla*. Again, plant volume better explained the pattern of plant use of *F. occidentalis* ($F = 33.27$, $df = 1$-11, $P = 0.0001$) $R^2 = 0.73$. We collected 5 thrips species - with enough abundance to be analyzed - restricted to flower feeding, 3 species had maximum occurrence in fall, one in spring and the other in summer. *Chirothrips falsus* Priesner, with 154 (86%) out of 179 specimens collected in Sep and Nov, was positively associated to *Gutierrezia* spp., *Z. acerosa, Dalea formosa Torr., Melampodium leucanthum* Torr. & Gray, *Thymophylla acerosa* DC., *Parthenium incanum* Kunth. and *Crotton pottsii* (Table 3). *Microcephalothrips abdominali*, with 153 (92%) out of 168 were collected in fall, was associated positively to *Z. acerosa*, *D. formosa, C. pottsii, T. acerosa, P. incanum* and *M. leucanthum* (Table 3). Thirteen (68%) out of 22 specimens of *F. minuta* (Moulton) were collected in summer on almost all host plants being at very low density (Table 3).

Maximum thrips abundances were observed during fall 1997 and spring 1998, no thrips were collected during winter. Five thrips species, *F. occidentalis, F. gossypiana* (Hood), *M. abdominalis, Chirothrips falsus Priesner,* and *N. signifer,* accounted for 92.20% of the total abundance in fall.

Discussion

The results of this study indicate that thrips showed low preference in the use of their host plants. The analysis of the effect of volume of different host plants showed that this variable

TABLE 3. POSITIVE (+) AND NEGATIVE (−) ASSOCIATIONS BETWEEN THRIPS AND PLANTS IN THE STUDY AREA. WRITTEN BELOW THE ASSOCIATION IS THE PROBABILITY. THOSE ASSOCIATIONS WHERE THE TEST WAS NOT ABLE TO DETECT SIGNIFICANT LOWER OR HIGHER ABUNDANCES THAN EXPECTED BY THE REGRESSION WERE CONSIDERED RANDOM ASSOCIATIONS AND WERE DENOTED AS NS, NO SIGNIFICANT.

Plant species Volume (m³)	Slope²	BL[1] 2.47	CP 0.06	DF 0.13	FC 0.55	GS 0.16	LT 1.04	M L 0.04	PI 0.19	PG 6.45	RM 6.03	TA 0.03	YE 1.11	ZA 0.04
Haplothrips graminis	3.76	(−) 0.00097	NS	NS	NS	NS	NS	NS	NS	(−) 0.00001	(−) 0.00001	(+) 0.00027	NS	NS
Leptothrips mali	5.14	(−) 0.00004	NS	NS	NS	NS	NS	NS	NS	(−) 0.00001	(−) 0.00001	(+) 0.00067	NS	NS
Arorathrips mexicanus	1.45	NS	NS	NS	(+) 0.00001	NS	NS	NS	NS	NS	NS	NS	NS	(+) 0.00001
Chirothrips falsus	16.81	(−) 0.00001	(+) 0.00001	(+) 0.00001	NS	(+) 0.00001	NS	(+) 0.00001	(+) 0.00015	(−) 0.00001	(−) 0.00001	(+) 0.00001	NS	(+) 0.00001
Chirothrips sp.	0.84	NS	NS	NS	(+) 0.00001	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bregmatothrips venustus	2.76	NS	NS	NS	NS	NS	NS	NS	NS	(−) 0.00001	(−) 0.00001	NS	NS	(+) 0.00001
Microcephalothrips abdominalis	18.82	(−) 0.00001	(+) 0.00001	(+) 0.00001	NS	NS	NS	(+) 0.00001	(+) 0.00140	(−) 0.00001	(−) 0.00001	(+) 0.00001	NS	(+) 0.00001
Frankliniella gossypiana	22.31	(−) 0.00001	(+) 0.00001	(+) 0.00001	NS	NS	(−) 0.00001	(+) 0.00001	NS	(−) 0.00001	(−) 0.00001	(+) 0.00001	NS	(+) 0.00001
Frankliniella minuta	1.82	NS	NS	NS	NS	NS	NS	NS	NS	NS	(−) 0.00020	(+) 0.00166	NS	NS
F. occidentalis	151.57	(−) 0.00329	(+) 0.00001	(+) 0.00001	(+) 0.00001	(+) 0.00001	(+) 0.00001	(+) 0.00001	(+) 0.00001	(−) 0.00001	(−) 0.00001	(+) 0.00001	(+) 0.00001	(+) 0.00001
Baileyothrips arizonensis	8.81	(−) 0.00069	NS	(+) 0.00023	NS	(+) 0.00001	(−) 0.00110	(+) 0.00001	(+) 0.00002	(−) 0.00001	(−) 0.00001	(+) 0.00001	NS	NS
Neohydatothrips signifer	37.74	(+) 0.00001	(+) 0.00008	NS	NS	(+) 0.00001	(−) 0.00029	NS	NS	(−) 0.00001	(−) 0.00001	NS	(−) 0.00001	NS

[1]BL = *Brickellia laciniata*, CP = *Croton pottsii*, FL = *Flourensia cernua*, GS = *Gutierrezia* spp, LT = *Larrea tridentata*, ML = *Melampodium leucanthum*, PI = *Parthenium incanum*, PG = *Prosopis glandulosa*, RM = *Rhus microphylla*, TA = *Thymophylla acerosa*, YE = *Yucca elata*, ZA = *Zinnia acerosa*.

[2]Expected value for each thrips-host plant combination was calculated by multiplying the regression slope x plant volume.

explained 80% of the variance in the thrips abundance. Larger plants had more thrips than smaller plants, for example, on *P. glandulosa*, the biggest plant, 905 thrips specimens were collected, whereas on *C. potsii, t*he smaller plant, 208 specimens were collected (Fig. 1). Interestingly, thrips richness was not related to thrips abundance or to plant volume (Fig. 2). Thrips richness on each host plant was quite similar among the 13 host plants. Thrips richness average per plant was 12, where 7 thrips species (the most abundant) were collected on all the 13 host plants studied and 2 thrips species on 12 plant species (Table 2), suggesting that all plants offered similar resources.

The pattern of plant usage by the thrips community was different from the pattern found on the leafhopper community studied at the same location, dates and host plants. The number of insect species analyzed was similar: 12 thrips and 13 leafhoppers (Logarzo et al. 2002). The Thysanoptera showed more positive interactions than leafhoppers (26.3% vs. 9.5%), indicating that thrips have low fidelity to host plants. All Thysanoptera species analyzed were positively associated at least with one plant species, and 41.7% were associated with many hosts, among 3-10 species (Table 3). On the other hand, 66.7% of the Cicadellidae showed preference for just 1-2 host plants (50% of the 13 leafhoppers were associated to only 1 host plant), and the remaining species (4) exhibited no preference for any host (Logarzo et al. 2002). When comparing negative interactions between Thysanoptera and Cicadellidae communities, the leafhoppers showed more avoidance associations in host usage than the thrips (41.4% of the 169 possible plant-leafhopper pairs demonstrated avoidance, whereas thrips showed 22.4% of the 156 pairs).

Given that the analysis of the thrips-plant associations was based on the frequency of the capture of thrips species on the 13 plant species sampled throughout the study without further preference studies, 2 causes can be responsible for the obtained capture pattern: insect behavior (like feeding, mating or oviposition) or sampling effect. For the purpose of this study, the sticky traps were the most indicated sampling method, because we do not detect differences in thrips captured among host plants in the preliminary sampling, and sticky traps have been widely used to sample thrips in many studies for different purposes (Diraviam & Uthamasamy1992; Higgins 1992; Cho et al.1995; Shipp et al. 2000; Finn 2003; Arévalo & Liburd 2007). However, some thrips specimens could of course be moved by winds and captured by traps set on plants that were not utilized by them, but those captures should be detected by the analysis and labeled as "random associations".

It is generally accepted that thrips lack controlled flight patterns, because their small size prevents them from counteracting the power of even moderate velocity winds; however, they can fly distances of 6-30 m depending on the species (Lewis 1997). In addition, thrips have some control over their landing (Lewis 1997) that is the basis for host selection. Kirk (1984) demonstrated that thrips actively select where to land. Based on color selection for landing, flower thrips flew to bright colors such as white, whereas grass-dwelling thrips flew to colors that were closer to green suggesting that thrips behavior is responsible for the observed pattern of plant use, and that behavior is ruled by the fundamental niche of each insect species that includes its feeding physiological host range.

Unfortunately, there are no host records for thrips in natural areas in the southwestern USA, and feeding habits of thrips in the USA are poorly known (Nakahara 1994; Hoodle et al. 2004; Diffie et al. 2008). Three main reasons could account for this, i.e., lack of studies that identify hosts where thrips complete their development; ignorance of feeding habits for most thrips species, even well known species, like *F. occidentalis,* a worldwide reputed pest of many crops (Mantel & Van de Vrie 1988; Cho et al. 1989; Gokkes 1991; Nicolas & Bennis 1993), is also known as facultative predator on other arthropods (Milne & Walter 1997; Agrawal et al. 1999); and finally, the low numbers of specimens collected of many thrips species. For example, in this study 14 out of 26 species sampled had abundances lower than10 specimens (Table 2).

Summary of Results of this Study. 1) few thrips species were found to be specialists; only 2 thrips species out of 12 studied, showed strong preference for host plants, 2) presence of a high percentage of positive associations, and a low percentage of negative associations; 3) the role of plant volume explaining more than 80% of variance of thrips abundance. The obtained results suggest that the studied thrips community has low plant specificity, and the pattern of plant use observed could be the consequence of generalist feeding diets.

References Cited

Agrawal, A. A., Kobashashi, C., and Thaler, J. S.. 1999. Influence of prey ability and induced host-plant re-

sistance on omnivory by western flower thrips. Ecology 80: 518-523.

ALLRED, K. 1988. A field guide to the flora of the Jornada plain. Agric. Exp. Statistics Bull. 739. New Mexico State Univ., Las Cruces, NM.

ARÉVALO, H. A., AND LIBURD, O. E. 2007. Horizontal and vertical distribution of flower thrips in southern highbush and rabbiteye blueberry plantings, with notes on a new sampling method for thrips inside blueberry flowers. J. Econ. Entomol. 100: 1622-1632.

CAMERON, A. C., AND TRIVEDI, P. K. 1998. Regression analysis of count data, Cambridge Univ. Press. ISBN 0-521-63201-3

CHO, J. J., MAU, R. F. L.,GERMAN, T. L., HARTMAN, R. W., YUDIN, L. S., GONSALVES, D. Y., AND PROVVIDENTL, R. 1989. A multidisciplinary approach to management of tomato spotted wilt virus in Hawaii. Plant Disease 73: 375-383.

CHO, K., ECKEL, C. S., WALGENBACH, J. F., AND KENNEDY, G. G. 1995. Comparison of colored sticky traps for monitoring thrips populations (Thysanoptera; Thripidae) in staked tomato fields. J. Entomol. Sci. 30: 176-190.

DIFFIE, S., EDWARDS, G. B., AND MOUND, L. A. 2008. Thysanoptera of southeastern U.S.A.: A checklist for Florida and Georgia. Zootaxa 1787: 45-62.

DIRAVIAM, J., AND UTHAMASAMY, S. 1992. A new sampling technique involving yellow sticky traps for monitoring of thrips infesting different crops. J. Entomol. Res. (New Delhi) 16: 78-81.

FINN, E. 2003. Developing integrated pest management (IPM) techniques for managing key insect pests of blueberries in the southern United States, pp. xi+99, Entomol. and Nematol. Dept. Univ. Florida, Gainesville, FL.

GOKKES, M. 1991. Glasshouse pest control in flower crops in Israel *In* Joint EPPO-IOLB/EPS. Conf. Plant Prot. Glasshouses, Naramowice (Poland). pp. 42-43.

HOODLE, M. S., MOUND, L. A., AND NAKAHARA, S. 2004. Thysanoptera recorded from California, U.S.A.: a checklist. Florida Entomol. 83: 317-321.

KIRK, W. D. J. 1984. Ecologically selective coloured traps. Ecol. Entomol. 9: 35-41. CrossRef, CSA.

LEWIS, T. 1997. Thrips as crop pests. CAB International. Wallingford, United Kingdom. 740 pp.

LOGARZO, G. A., RICHMAN, D. B., AND GOULD, W. R. 2002. Plant use patterns of a guild of leafhoppers on a woody plant community in the Chihuahuan Desert. Environ. Entomol. 31: 914-922.

MANTEL W. P., AND VAN DE VRIE, M. 1988. A contribution to the knowledge of Thysanoptera in ornamental and bulbous crops in the Netherlands. Acta Phytopathol. Entomol. Hungarica 23: 301-311.

MILNE, M., AND WALTER, G. H. 1997. The significance of prey in the diet of the phytophagous thrips, *Frankliniella schultzei*. Ecol. Entomol. 22: 74–81.

MORITZ, G., MOUND, L. A., MORRIS, D. C., AND GOLDARAZENA, A. 2004. Pest thrips of the world: an identification and information system using molecular and microscopical methods. CD-ROM. Brisbane: Cent. Biol. Inf. Technol.

NAKAHARA, S. 1994. The genus Thrips Linnaeus (Thysanoptera: Thripidae) of the New World. U.S. Dep. Agric. Tech. Bull. 1822: 1-183.

NICOLAS, J. Y., AND BENNIS, A. 1993. Le thrips californien sur pécher en Roussillon. Phytoma- La defense des végétaux 449: 19-23.

PATIL, A., HUARD, D., AND FONNESBECK, C. J. 2010. PyMC: Bayesian Stochastic Modelling in Python. J. Statistical Software, 35(4) 1-81.

PINENT, S. M. J., ROMANOWSKI, H. P., REDAELLI, L. R., AND CAVALLERI, A. 2006. Species composition and structure of Thysanoptera communities in different microhabitats at the Parque Estadual de Itapua, Viamao, RS. Brazilian J. Biol. 66: 765-779.

ROBERT, C. P., AND CASELLA. G. 2004. Monte Carlo Statistical Methods (second edition). New York: Springer-Verlag.

SHIPP, J. L., WANG, K., AND BINNS, M. R. 2000. Economic injury level for western flower thrips (Thysanoptera: Thripidae) on greenhouse cucumber. J. Econ. Entomol. 93: 1732-1740.