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Thysanoptera diversity associated with Mexican lemon (*Citrus aurantifolia* Christm.)

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ABSTRACT

Objective: To calculate the monthly relative abundance of *Thysanoptera* species, according to the Margalef, Simpson and Shannon-Wiener diversity indices.

Design/Methodology/Approach: The work was carried out in three geographic units with conventional management, during January-December, 2019 in the Reserva de la Biosfera Zicuirán-Infiernillo (Biosphere Reserve), Michoacán, Mexico. In each unit, 10 trees were selected through simple random sampling. Thrips counts were performed on ten shoots per tree every 15 d, for a total of 7200 shoots in the three geographic units. *Thysanoptera* individuals were placed in entomological jars. The variables were: number of thrips collected per shoot in sampled tree and geographic unit (orchard). To estimate the specific richness and structure of species, the program "calculation of diversity indices DIVERS" was used.

Results: In the three geographical units studied, the recorded presence of *Thysanoptera* accounted for 12 to 17 species. For Nueva Italia 12 recorded species, two were permanent (16.66%), five abundant (41.66%), one scarce (8.3%) and four rare (33.33%). In Zicuirán, three species were permanent (17.64%), six abundant (35.29%), two scarce (11.76%) and six rare (35.29%). In Los Hoyos, four species were permanent (26.66%), four abundant (26.66%) and seven rare (46.66%). The abundance of species was represented by the genus *Frankliniella* and the species *Scolothrips sexmaculatus* and *Scirtothrips citri*. The highest species richness and abundance was found from January to May. In October and November, the value of the calculated indices was zero, which shows less richness and abundance of individuals. The best species uniformity was recorded during January and December, which meant a more stable and homogeneous relation.

Study limitations/Implications. Pest resurgence, presence of *Candidatus liberibacter* spp. and its vector *Diaphorina citri*.

Findings/Conclusions: in Nueva Italia, 12 species were taxonomically determined; in Los Hoyos 15, and in Zicuirán 17 species, which are reported for the first time in the state of Michoacán, Mexico. At the geographic unit "Los Hoyos" diversity was higher, uniform and stable.

Keywords: *Citrus*, *Frankliniella bispinosa*, *Scolothrips sexmaculatus*, *Scirtothrips citri*, thrips.

INTRODUCTION

The concept of diversity has been intensively discussed by ecologists for years, deriving some semantic, conceptual, and technical problems (Hurlbert, 1971). Diversity indices then, provide utility and scientific relevance, despite some debates and precautions

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which may arise when applying them. High levels of biodiversity suggest good functions in the ecosystems, a high capacity to react to external pressures and optimal adaptation to a changing environment (Odum and Warrett, 2008). Diversity studies make it possible to relate changes in the composition of species with environmental and edaphic variables (Durán and Zambrano, 2002), and also suggest obtaining a more detailed scenario of the interrelations among environmental factors and the distribution of species (Palmer *et al*., 2000).

For the diversity-alpha represents the species in a specific habitat, its importance relies on the application of the Simpson (Simpson, 1949), and Shannon-Wiener (Shannon, 1948) indices that express the values of richness and relative abundance in an agroecosystem. Low equity (or high dominance by few species) or equity in the representation of individuals of each species detected in the samplings (Carmona and Carmona, 2013). The advantage of the indices is that they summarize diverse information in a single value and allow comparisons, via statistical verification, between the diversity at the same or different habitats over time (Moreno, 2001). Mexico along with Brazil, Colombia and Indonesia rank among the first places of species richness on the planet (Ceballos *et al*., 2005).

In Mexico, the Zicuirán-Infiernillo Biosphere Reserve, in Michoacán, is the Protected Natural Area that preserves one of the most fragile and riskiest ecosystems, such as the dry tropical forest, which is also a provider of environmental goods and services such as the water catchment, soil retention, climate regulation, carbon reduction in the atmosphere, hydrological services; and it is an important site which concentrates a great diversity of species and endemism (SEMARNAT, 2006).

From an agricultural point of view, citrus (*Citrus* sp.) is the main crop in this region. Trees that have multiple shoots throughout the year, thanks to the warm climate, with the absence of a defined winter, which favors the presence of diverse biological organisms (Medina *et al*., 2001). Thrips are among them, playing an important role, by reducing the yield and quality of the fruits (Curti *et al*., 2000). Given the great importance that this group of insects represents in the cultivation of Mexican lemon (*Citrus aurantifolia*), it was considered to carry out this work in the Zicuirán-Infiernillo Biosphere Reserve, with the objective of calculating the monthly relative abundance of the *Thysanoptera* species, according to the Margalef, Simpson and Shannon-Wiener diversity indices.

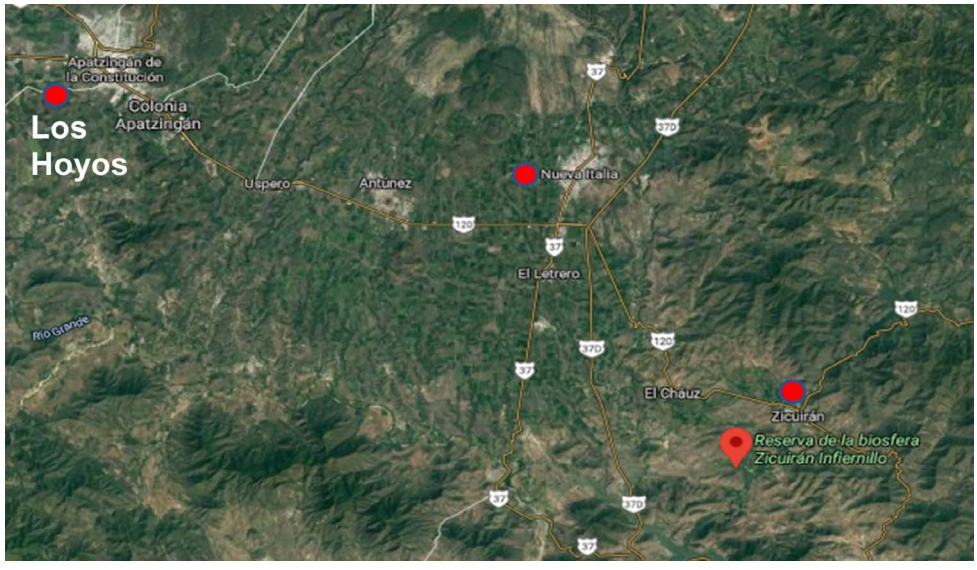

Figure 1. Location of the three geographic units, in the Zicuirán-Infiernillo Biosphere Reserve (Rzedowski 1978; Google Earth, 2020).

MATERIALS AND METHODS

The work was carried out in three geographic units or Mexican lemon orchards with conventional management, from January to December 2019. These units were ejidos 1) Nueva Italia, municipality of Fco. J. Mújica; 2) Zicuirán, municipality of Huacana; and 3) Los Hoyos municipality of Apatzingán, Michoacán, Mexico. The three areas are located in the Zicuirán-Infiernillo Biosphere Reserve, considered a great valley in which altitudes above sea level fluctuate from 200 m in the lower parts to 1600 m in the highland areas that delimit it (Rzedowski, 1978; INEGI 1985) (Figure 1).

In each unit, ten trees were selected by simple random sampling (Castillo, 2002). Thrips counts were made on ten shoots per tree every 15 d, to make a total of 7200 shoots in the three geographic units. The methodology consisted of washing the vegetative parts with a spray bottle containing soapy solution (5 mL of cationic softener® in 95 mL of water),

in order to collect the thrips (Johansen, 1987). A plastic container 25 cm long by 20 cm wide and 8 cm deep was placed at the bottom of the atomizer and the bud. Stored contents were then filtered on an analytical sieve with tight permanent tissue with a measuring range of 45 μm so that the insects would remain on the mesh and we can easily isolate them with a brush. *Thysanoptera* were deposited in entomological flasks containing 70% alcohol, with their respective passport data. The variables studied were the number of thrips collected per shoot in the sampled tree and geographic unit (orchard). To know the specific richness and structure of species, the program "calculation of diversity indices DIVERS" was used (Pérez and Sola, 1993), and in this study, they were the following:

Margalef Diversity Index

$$D_{Mg} = \frac{S-1}{\ln N}$$

Table 1. Number of *Thysanoptera* individuals per species and geographical unit, in the Zicuirán-Infiernillo Biosphere Reserve, Michoacán, Mexico. 2019.

Especie	Unidades geográficas		
	Nueva Italia	Los Hoyos	Zicuirán
Scirtothrips citri	369	372	465
Leptothrips mcconnelli	97	92	83
Scolothrips sexmaculatus	395	444	466
Frankliniella cephalica	250	204	94
Liothrips mexicanus	1	0	0
Karnyothrips sp.	1	3	3
Frankliniella bispinosa	185	252	238
Lacandonithrips elegantis	1	2	0
Microcephalothrips sp. 1	1	0	0
Frankliniella curticornis	205	126	124
Frankliniella minuta	187	69	63
Stomatothrips brunneus	20	40	30
Scolothrips pallidus	0	0	51
Liothrips sp.	0	1	1
Microcephalothrips sp. 2	0	0	2
Leptothrips macro-ocellatus.	0	2	2
Frankliniella insularis	0	0	10
Scirtothrips totonacus	0	0	1
Leucothrips theobromae	0	0	1
Caliothrips phaseoli	0	0	10
Frankliniellia cubensis	0	3	0
Leucothrips furcatus	0	1	0
Neurothrips punanus	0	1	0
Número total de individuos (N)	1712	1612	1644
Número total de especies (S)	12	15	17

where: S=number of species. N=total number of individuals.

Its result, generally, is different from "zero" (Mallet, 1996). To know the dominance of species, the Simpsom Index was calculated

$$\lambda = \sum p_i^2$$

where: p_i^2 =proportional abundance of species "*i*", that is, the number of individuals of species "*i*" divided by the total number of individuals in the sample. This value shows the probability that two individuals, taken at random from a sample, are of the same species. To know the average uncertainty, the Equity Index (Shannon-Wiener) was calculated (Moreno, 2001).

$$H' = -\sum(p_i \ln p_i)$$

RESULTS AND DISCUSSION

This work exemplifies the use of effective numbers of species that give confidence and consistency to the biological diversity of thrips. Species numbers also comply with a series of mathematical properties, consistent with the intuitive interpretation of the biological concept of diversity (Jost, 2006), and that avoid plausibly inaccurate conclusions in conservation biology (Jost *et al.*, 2010). In the three geographic units studied, the recorded presence of *Thysanoptera* in *Citrus aurantifolia* trees was 12 to 17 species (Table 1, Figure 2).

Table 1 shows that the number of species of thrips shows heterogeneity within an ecosystem, since the minimum value was 12 and the maximum 17, respectively. Case and Cody (1987) point out that the appreciation of biota in a given place is influenced not simply as a relic of past historical events, but as an entity in constant change. Halffter and Escurra (1992) attribute the simplification of ecosystems to the application of toxic products, which result in biomass and diversity losses. In Nueva Italia, of 12 registered species, two were permanent (16.66%), five abundant (41.66%), one scarce (8.3%) and four rare (33.33%). In Zicuirán, three species were permanent (17.64%), six abundant (35.29%), two scarce (11.76%) and six rare

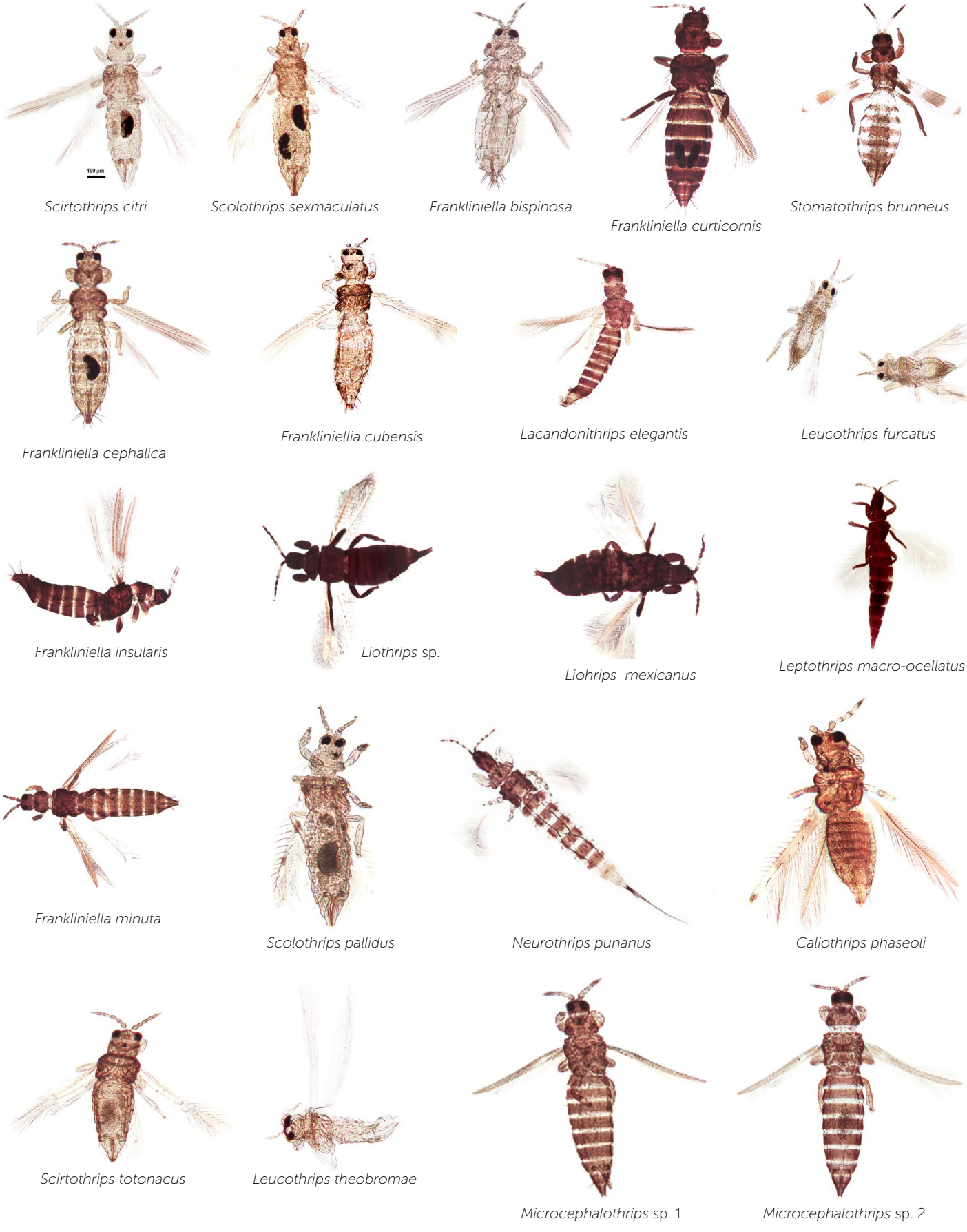

Figure 2. *Thysanoptera* genera and species collected in vegetative shoots of Mexican lemon, in three geographic units of the Zicuirán-Infiernillo Biosphere Reserve, Michoacán, Mexico; 2019.

(35.29%). In Los Hoyos, four species were permanent (26.66%), four abundant (26.66%) and seven rare (46.66%) (Table 2).

The information in Table 2 coincides with Segnini (1995), when mentioning that biodiversity depends not only on species richness, but on the relative dominance and abundance of each of them. As well as on the physical structure of the environment, since some species of thrips can just stay on, others feed of, and some others reproduce on plants (Mound, 1997). According to the number of individuals collected monthly per species (Table 3, 4 and 5), the diversity indices were calculated for each geographic unit (Table 6, 7 and 8).

Regarding Tables 3, 4, and 5, it can be seen that the species distribution pattern is only explained by the physical conditions of the environment. At the same time, it is observed that the abundance of species in the three localities was represented mainly by the genus Frankliniella and the species *Scolothrips sexmaculatus* and *Scirtothrips citri*. The percentage of *Thysanoptera* previously mentioned at Nueva Italia was 92.92, at Los Hoyos, 91.19; and at Zicuirán 88.80. The above coincides with classic works by Moulton (1948), Priesner (1933) and Wilson and Schmida (1984), cited by Johansen (1987), who points out the importance of thrips in Mexico, where the *Frankliniella* genus stands out. Pertaining to the absence or reduced number of collected thrips, perhaps because the specific microhabitat where they live is unknown; because their reproduction is scarce, due to the phytosanitary management that is carried out in the crops; or, in other cases, because there have not been recent collections in the localities. However, the results obtained are important for Entomology since, according to the Thysanopterii-fauna inventory of the year 1993, from the state of Michoacán only 9.3% of Suborder *Terebrantia* and 22.85% of Tubulifera within the total species described in the country (Johansen 1987) are known. Halffter (1998) and Zuccaro and Bulla

Table 2. *Thysanoptera* species in *C. aurantifolia*, grouped into abundance classes, in three geographic units in the Zicuirán-Infiernillo Biosphere Reserve, Michoacán, Mexico. 2019.

Locality	Species			
	Permanent [z]	Abundant [y]	Scarce [x]	Rare [w]
Nueva Italia	*S. sexmaculatus*	*S. citri*	*S. brunneus*	*Karnyothrips* sp.
	F. bispinosa	*L. mcconnelli*		*Liothrips mexicanus*
		F. cephalica		*L. elegantis*
		F. curticornis		*Microcephalothrips* sp. 1
		F. minuta		
Zicuirán	*S. sexmaculatus*	*F. cephalica*	*F. insularis*	*Liothrips* sp.
	S. citri	*F. bispinosa*	*C. phaseoli*	*Karnyothrips* sp.
	L. mcconnelli	*S. pallidus*		*Microcephalothrips*. sp. 2
		F. curticornis		*Leptothrips* sp.
		F. minuta		*S. totonacus*
		S. brunneus		*L. theobromae*
Los Hoyos	*S. sexmaculatus*	*L. mcconnelli*		*Liothrips* sp.
	S. citri	*F. cephalica*		*Karnyothrips* sp.
	F. bispinosa	*F. minuta*		*L. elegantis*
	F. curticornis	*S. brunneus*		*F. cubensis*
				L. furcatus
				Leptothrips sp.
				N. punanus

[z] Present for 11 and 12 months of the year; [y] present for eight to ten months; [x] present from three to seven months; [w] present in one and two months of the year.

S. sexmaculatus=Scolothrips sexmaculatus, S. citri=Scirtothrips citri, S. brunneus=Stomatothrips brunneus, F. bispinosa=Frankliniella bispinosa, L. mcconnelli=Leptothrips mcconnelli, F. cephalica=Frankliniella cephalica, F. curticornis= Frankliniella curticornis, F. minuta=Frankliniella minuta, L. elegantis=Lacandonithrips elegantis, S. palidus=Scolothrips pallidus, F. insularis=Frankliniella insularis, C. phaseoli=Caliothrips phaseoli, S. totonacus=Scirtothrips totonacus, L. theobromae=Leucothrips theobromae, F. cubensis=Frankliniellia cubensis, L. furcatus=Leucothrips furcatus, N. punanus=Neurothrips punanus.

Table 3. Number of recorded thrips of each species of *Thysanoptera* per month, in the *C. aurantifolia* cultivation at the geographic unit ejido Nueva Italia, Michoacán. 2019.

Species	Number of thrips collected in *C. aurantifolia*												Total
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	
S. citri	67	54	79	51	53	41	12	8	2	0	0	2	369
L. mcconnelli	11	12	21	17	13	9	8	5	0	0	0	1	97
S. sexmaculatus	61	56	68	62	65	39	20	10	3	2	3	6	395
F. cephalica	54	27	60	32	34	21	10	6	2	1	0	3	250
L. mexicanus	0	1	0	0	0	0	0	0	0	0	0	0	1
Karnyothrips sp.	0	0	0	1	0	0	0	0	0	0	0	0	1
F. bispinosa	26	23	38	29	26	21	8	7	3	1	1	2	185
L. elegantis	0	0	0	0	0	0	1	0	0	0	0	0	1
Microcephalothrips sp. 1	0	0	0	0	0	1	0	0	0	0	0	0	1
F. curticornis	39	31	37	27	24	22	17	7	0	0	0	1	205
F. minuta	24	20	38	35	31	22	14	3	0	0	0	0	187
S. brunneus	2	4	1	3	5	3	1	0	1	0	0	0	20
Accumulated species	**8**	**9**	**9**	**10**	**10**	**11**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Table 4. Number of recorded thrips of each species of *Thysanoptera* per month, in the *C. aurantifolia* cultivation at at the geographic unit ejido Zicuirán, Michoacán. 2019.

Species	Number of thrips collected in *C. aurantifolia*												Total
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	
S. citri	71	68	67	69	65	53	49	14	4	0	0	5	465
L. mcconnelli	19	21	12	9	11	5	3	2	0	0	0	1	83
S. sexmaculatus	82	74	69	61	57	53	46	21	0	0	0	3	466
S. pallidus	18	11	7	3	9	0	2	0	0	0	0	1	51
F. cephalica	21	13	11	16	10	12	7	4	0	0	0	0	94
Liothrips sp.	0	0	0	0	1	0	0	0	0	0	0	0	1
Karnyothrips sp.	1	2	0	0	0	0	0	0	0	0	0	0	3
F. bispinosa	42	47	39	42	36	21	9	0	0	0	0	2	238
F. curticornis	27	22	25	13	21	13	3	0	0	0	0	0	124
F. minuta	13	17	11	9	7	2	4	0	0	0	0	0	63
S. brunneus	8	3	5	7	2	0	1	2	0	0	2	0	30
Microcephalothrips sp. 2	0	0	1	0	0	0	1	0	0	0	0	0	2
L. macro-ocellatus	0	0	0	0	0	0	0	1	1	0	0	0	2
F. insulares	4	0	2	1	0	0	1	2	0	0	0	0	10
S. totonacus	0	0	0	1	0	0	0	0	0	0	0	0	1
L. theobromae	0	0	0	1	0	0	0	0	0	0	0	0	1
C. phaseoli	6	0	0	2	1	0	0	0	0	0	0	0	9
Accumulated species	**12**	**12**	**13**	**15**	**16**	**16**	**17**	**17**	**17**	**17**	**17**	**17**	**17**

(1985), point out that it is difficult to imagine a social development like the current one, without affecting the natural environment, and the most fragile element is biodiversity, which is why abundance of species was contrasting.

The values in Table 6 show that, during the months of March, May, August, September and October, the uniformity value was higher, which means the relation that exist between abundance and species richness, since collected individuals presented roughly the same

Table 5. Number of recorded thrips of each species of *Thysanoptera* per month, in the cultivation of *C. aurantifolia* at the geographic unit ejido Los Hoyos, Michoacán, Mexico. 2019.

Species	Number of thrips collected in *C. aurantifolia*												Total
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	
S. citri	62	56	58	60	48	35	24	13	6	2	3	5	372
L. mcconnelli	16	18	21	13	7	9	6	2	0	0	0	0	92
S. sexmaculatus	66	71	73	72	53	42	31	15	6	4	2	9	444
F. cephalica	38	32	41	34	28	19	9	2	0	0	0	1	204
Liothrips sp.	0	0	0	0	0	0	0	0	0	0	0	1	1
Karnyothrips sp.	0	2	1	0	0	0	0	0	0	0	0	0	3
F. bispinosa	31	39	46	41	37	29	11	9	2	0	1	6	252
L. elegantis	0	0	1	0	0	1	0	0	0	0	0	0	2
F. cubensis	0	0	0	0	1	0	2	0	0	0	0	0	3
L. furcatus	1	0	0	0	0	0	0	0	0	0	0	0	1
L. macro-ocellatus	1	0	0	0	0	0	0	0	0	0	0	1	2
F. curticornis	14	17	23	24	18	13	9	3	1	0	1	3	126
F. minuta	12	9	11	13	10	7	5	2	0	0	0	0	69
S. brunneus	7	9	3	6	9	2	0	0	0	0	1	3	40
N. punanus	1	0	0	0	0	0	0	0	0	0	0	0	1
Accumulated species	**11**	**12**	**13**	**13**	**14**	**14**	**14**	**14**	**14**	**14**	**4**	**15**	**15**

Table 6. Result of the DIVERS program that shows the diversity indices corresponding to the geographical unit of ejido Nueva Italia, Michoacán 2019 (Pérez and Sola, 1993).

Month	No. of individuals (abundance)	Species richness (S)	Uniformity (E)	Index			ln "S"[z]
				Margalef	Simpson	Shannon	
February	228	9	0.86670	1.47342	0.160	1.90	2.197
March	342	8	0.90518	1.19974	0.161	1.88	2.079
April	257	9	0.87884	1.44168	0.156	1.93	2.197
May	251	8	0.91275	1.26685	0.164	1.89	2.079
June	179	9	0.88093	1.54220	0.155	1.93	2.197
July	91	9	0.89697	1.77350	0.142	1.97	2.197
August	46	7	0.97328	1.56714	0.138	1.89	1.945
September	11	5	0.96096	1.66813	0.145	1.54	1.605
October	4	3	0.94639	1.44270	0.166	1.03	1.098
November	4	2	0.81128	0.72135	0.500	0.56	0.693
December	15	6	0.88560	1.84635	0.190	1.58	1.79

[z] Natural logarithm of species richness.

amount in their respective species. The value of the Margalef index (0.72135) indicates that in the month of November there was no species richness, since only three individuals of *S. sexmaculatus* and one of *F. bispinosa* were collected. The main characteristic of this index is that the higher its value (greater than one), the greater diversity exists.

In the Simpson index, the maximum value was obtained in the month of November (0.500) close to one, which indicates that in this month diversity was lower. But, at the same time, this value represents a 50% probability that, of the four individuals collected, two taken at random, would be of the same species. However, in the months from December to October, as the species richness (S) and number of individuals increased, the value of the Simpson index decreased (0.1). Referring to the Shannon index, when its value is equal to zero, most of the individuals in a population correspond to the same species. Thus, the higher it is or it approaches

Table 7. Result of the DIVERS program that shows the values of the diversity indices corresponding to the geographical unit of ejido Zicuirán, Michoacán, 2019 (Pérez and Sola, 1993).

Month	No. of individuals (abundance)	Species richness (S)	Uniformity (E)	Index			ln "S"[z]
				Margalef	Simpson	Shannon	
February	278	10	0.83358	1.59925	0.174	1.91938	2.302
March	249	11	0.78884	1.81234	0.188	1.89157	2.397
April	234	13	0.73490	2.19969	0.195	1.88499	2.564
May	220	11	0.77280	1.85404	0.194	1.85310	2.397
June	159	7	0.80340	1.18369	0.248	1.56335	1.945
July	127	12	0.63842	2.27076	0.285	1.58642	2.484
August	46	7	0.73210	1.56714	0.299	1.42460	1.945
September	5	2	0.72193	0.62133	0.600	0.50040	0.693
October	0	0	0.0	0.0	0.0	0.0	0.0
November	2	0	0.0	0.0	0.0	0.0	0.0
December	12	5	0.88486	1.60972	0.212	1.42413	1.609

[z] Natural logarithm of species richness.

Table 8. Result of the DIVERS program that shows the diversity indices corresponding to the geographical unit of ejido Los Hoyos, Michoacán, 2019 (Pérez and Sola, 1993).

Month	No. of individuals (abundance)	Species richness (S)	Uniformity (E)	Index			ln "S"[z]
				Margalef	Simpson	Shannon	
January	249	11	0.79055	1.81243	0.17820	1.89565	2.397
February	253	9	0.85801	1.44577	0.17642	1.88525	2.197
March	278	10	0.81496	1.59925	0.17290	1.87652	2.302
April	263	8	0.88871	1.25625	0.17862	1.84803	2.079
May	211	9	0.85770	1.49481	0.17174	1.88457	2.197
June	157	9	0.84266	1.58220	0.17712	1.85152	2.197
July	97	8	0.86715	1.53015	0.19201	1.80319	2.079
August	46	7	0.83701	1.56714	0.21739	1.62875	1.945
September	15	4	0.85279	1.10781	0.29524	1.18222	1.386
October	6	2	0.91830	0.55811	0.46667	0.63651	0.693
November	8	5	0.92838	1.92359	0.14286	1.49418	1.609
December	29	8	0.87038	2.07882	0.16502	1.80999	2.079

[z] Natural logarithm of species richness.

to the ln (natural logarithm) of "S" (species richness), the greater the diversity and, according to the discriminatory criterion of the statistical program proposed by Pérez and Sola (1993), it is inferred that in most months of the year there was a general population rich in species.

Table 7 shows that the highest species richness and abundance was from January to May. In October and November, the value of the calculated indices was zero, which means less richness and abundance of individuals. The values corresponding to uniformity in the months of January and December were the highest, which meant a more stable and homogeneous relation among species. When analyzing the Margalef index, it can be seen that in the months of October and November its result was zero and, according to Moreno *et al*. (2001), when this result is obtained there is no richness and the population studied is represented by a single species. However, in the months of April and July, their values were 2.19969 and 2.27076, respectively, which means that the higher the richness, the higher the abundance of species. In the Simpson index, the highest value corresponded to the month of September (0.600). During this month only two species were collected: *Scirtothrips citri*, with four individuals, and *Leptothrips macro-ocellatus*, with one. This means that if two individuals are chosen at random, there is a high probability that both would correspond to *S. citri*,

suggesting strong influence by the dominant species. In relation to the Shannon-Wiener index, the highest value (2.06303) was recorded in January and represented high uncertainty that two individuals taken at random were of the same species, since the abundance was more uniform when collecting 12 out of 17 species reported in our study, with an average collection of 26 individuals per month in each one. These data coincide with that reported by González and Torruco (2001), by pointing out that when this index increases, the diversity in the study area is greater. On the contrary, in the month of September, the value was 0.50040, which represents low uncertainty that two individuals taken at random would correspond to the same species.

The values in Table 8 indicate that the uniformity was stable, so that the equity among the different species was more homogeneous. As at the geographical unit ejido Nueva Italia, at least one species was present throughout the year. According to Magurran (1988), in an ecological context, the components of an ecosystem, such as "variety and relative abundance of species", are well correlated. In addition, they indicate the way in which resources and energy are shared in the biological systems and populations (Sheldon, 1969). The Margalef index, in the month of October, presented the lowest value (0.55811) when collecting four individuals of *S. sexmaculatus* and two of *S. citri*. These values are closely related to the Simpson index, whose highest value was 0.46667. The value of the Shannon-Wiener index, in the month of October, represented low uncertainty, by indicating to which species the next collected individual will belong, since two species were recorded that month, of which *S. sexmaculatus* was dominant. The values corresponding to the other months represented high uncertainty, since their value was close to the natural logarithm of "S" (species richness).

The information obtained in the three locations shows that the species were distributed, according to their hierarchy of abundance, from very abundant to some very rare. According to what Halffter and Ezcurra (1992) cited, the greater the degree of dominance of some species and rarity of the others, the lower the biodiversity in the community. However, Peet (1974) points out that it is normal to find these conditions, since the earth is nothing more than a fine mosaic of conditions and resources that define different niches that are habitable or not by different species.

CONCLUSIONS

In Nueva Italia, 12 species were taxonomically determined; in Los Hoyos, 15; and in Zicuirán, 17, the latter are reported for the first time for Michoacán, Mexico. In the three units, the abundance of species was represented by five species: *Scirtothrips citri*, *Frankliniella bispinosa*, *F. cephacila*, *F. curticornis* and *Scolothrips sexmaculatus*. While *Liothrips* sp., *Stomatothrips totonacus*, *Leucothrips theobromae, Leucothrips furcatus*, *Neurothrips punanus*, *Leptothrips elegantis*, *Leptothrips* sp., *Karnyothrips* sp., and *Microcephalothrips* sp.1 were registered as rare species, since, on average, just one to three individuals of each species were collected during the year. The species *Stomatothips brunneus*, *Frankliniella insularis* and *Caliothrips phaseoli* were also considered scarce species. In the geographical unit Los Hoyos, diversity was higher, homogeneous and stable, compared to that registered in Nueva Italia and Zicuirán.

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