

Presence of the Thrips *Gynaikothrips uzeli* and Its Predator *Montandoniola confusa* in *Ficus benjamina*

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Abstract

Gynaikothrips uzeli Zimmermann (Thysanoptera: Phlaeothripidae) is a gall-inducing thrips that has been observed on *Ficus* in urban trees, reducing its photosynthetic capacity and ornamental value. The objective of this study was to contribute to the understanding of the population dynamics and predator-prey relationships over a five-month period of *G. uzeli* and its natural enemies on *Ficus benjamina*. Biweekly samples were collected at two sites in Irapuato, Guanajuato, Mexico, between January and May 2023. A total of 100 infested *Ficus benjamina* (Moraceae) leaves were collected, with thrips and predators quantified. Presence of *Gynaikothrips uzeli* (Thysanoptera: Phlaeothripidae) and its predator *Montandoniola confusa* Streito (Hemiptera: Anthocoridae) was confirmed. A total of 634 thrips nymphs, 507 predator nymphs, 5691 adult thrips, and 56 adult predators were recorded. Significant positive correlations were found between thrips and predator populations for both immature and adult stages ($R^2 = 0.91$ and $R^2 = 0.92$, respectively). Thrips populations peaked in January (nymphs) and February-March (adults), while predator nymphs dominated from February to April. Abundances were higher at the older *Ficus* trees. This study contributes to understanding interactions of gall thrips and their predators on ornamental *Ficus* trees in Mexico.

Keywords

Gall-Inducing Thrips, Thysanoptera: Phlaeothripidae, Urban Trees, Natural Enemies, Hemiptera: Anthocoridae

1. Introduction

There are around 5000 species of thrips, many of which are of agricultural im-

portance. Thrips exhibit thigmotactic behavior—they hide and prefer plant buds, flowers, fruits, etc. The female's ovipositor is saw-shaped, which she uses to insert eggs into plant tissue [1]. One of the most evolved groups of thrips belongs to the family *Phlaeothripidae*; they produce galls that form when they feed on the leaf and stimulate meristematic activity in plant cells. *Gynaikothrips uzeli* Zimmermann (Thysanoptera: Phlaeothripidae) forms a simple gall by causing the leaf to fold adaxially along the central vein of *Ficus* spp. (Moraceae) [2]. This gall is not completely closed, so the *G. uzeli* colony is exposed to intense evaporation and attacks by natural enemies [3]. It can cause a 41% reduction in leaf surface area, decrease photosynthetic activity, and reduce the commercial value of the plant due to leaf discoloration and curling. Additionally, thrips can be bothersome as they land on humans and bite, causing skin irritation [4]. The Moraceae family is the most frequently attacked by gall-forming thrips, with 11 genera known to cause such malformations, although some are opportunistic and exploit abandoned galls [5]. *G. uzeli* was first reported in 2003 in the United States. It is native to China and India and is widely distributed in the southeastern United States and California [6]. It forms simple galls exclusively on *Ficus benjamina* [2].

Galls on *Ficus benjamina* naturally harbor the predatory thrips *Androthrips ramachandrai* Karny (Thysanoptera) and the anthocorid *Montandoniola confusa* Streito and Matocq (Hemiptera: Anthocoridae), which feed on *G. uzeli* [7]. Soto-Rodríguez *et al.* [8] published identification keys for thrips species on ornamental plants and reported that *Gynaikothrips uzeli* is commonly found colonizing *Ficus benjamina* L. in the state of Nayarit, Mexico.

Due to the increasing presence of galls caused by *Gynaikothrips uzeli* Zimmermann (Thysanoptera: Phlaeothripidae) on *Ficus* in urban trees and the limited information available on this insect, the objective of this study was to contribute to the understanding of the life cycle of *G. uzeli* and its natural enemies on *Ficus benjamina*.

2. Materials and Methods

2.1. Collection

Biweekly collections were carried out at two locations: “El Copal,” in the Life Sciences Division (DICIVA) of the University of Guanajuato (20°44'24"N; 101°20'12"W; 1750 masl), and the trees at the Instituto Tecnológico Superior de Irapuato (ITESI) (20°44'33.9"N; 101°19'59.9"W; 1850 masl). A total of 100 infested *Ficus benjamina* (Moraceae) leaves were collected directly from each of the two sampling sites. The leaves were placed in 100 ml jars containing 70% alcohol. The number of nymphs and adults of *G. uzeli*, as well as nymphs and adults of the anthocorid *M. confusa*, were counted. Species identification of thrips was conducted using the keys by Soto-Rodríguez *et al.* [8] and Mound and Marullo [9], and identification of the anthocorid was based on Pluot-Sigwalt *et al.* [10].

2.2. Statistical Analysis

Prior to the binomial regression analysis, a normality test was conducted using

the Shapiro-Wilk test, a homogeneity of variances test was conducted using Levene's test, and a lack-of-fit test was performed. Binomial regression analyses were performed between the following variables: bug nymphs as the dependent variable and thrips nymphs as the independent variable. The same categories of variables were considered for adult bugs and adult thrips. A one-way ANOVA was also conducted to compare the number of nymphs per period; since the data did not show homogeneity of variance, they were transformed using the natural logarithm (ln). In cases of significant differences, Tukey's test was used. Analyses were performed using the InfoStat software.

The identified material is preserved in the "Leopoldo Tinoco Corona Entomological Collection," Department of Agronomy, University of Guanajuato in Irapuato.

3. Results and Discussion

Presence of *Gynaikothrips uzeli* (Thysanoptera: Phlaeothripidae) and its predator *Montandoniola confusa* Streito (Hemiptera: Anthocoridae) was confirmed; this aligns with the findings that noted that this species is common on *Ficus benjamina* and forms a simple gall (folded leaf), generally on young leaves and on the outer part of the foliage, not on mature leaves, nor does it penetrate deeper than 20 cm [8]. In this regard, it has been reported that *G. uzeli* shows a preference for the volatile organic compounds emitted by *F. benjamina* over those emitted by *F. microcarpa* and *F. elastica* [11]. Other species of gall-inducing thrips trigger more complex growths such as rosettes, blisters, and pouches [2]. On the other hand, it has been reported that *Gynaikothrips ficorum* Marchal is exclusively associated with *F. microcarpa* (Moraceae) [4]; for this plant, up to three species of gall-forming insects have been reported, affecting not only the leaves but also the branches and trunk—the latter causing greater damage due to interference with sap flow [12].

3.1. Relationship between Nymphs of the Thrips *G. uzeli* and the Anthocorid *M. confusa*

A total of 507 nymphs of *M. confusa* (15.84 ± 2.43) and 634 nymphs of *G. uzeli* (19.81 ± 4.44) were collected. A significant regression was found ($R^2 = 0.91$; $F = 5.64$, $p = 0.024$) between the number of bug nymphs and the number of thrips nymphs (Figure 1).

The presence of *G. uzeli* nymphs was highest in January (Figure 2), while the predator *M. confusa* was more abundant than its prey from February to April. Later, thrips nymphs increased in number relative to the anthocorid. Although climatic conditions were not recorded during this study, the presence of thrips nymphs was greater during the winter, when temperatures in the study area range between 7°C and 24°C, according to local records. Retana *et al.* [5] indicated that the gall forms a microclimate ideal for the development of immature stages, protecting them from variations in abiotic factors. Microclimates provide a favorable

environment for thrips, as noted by Kaur *et al.* [13] for *Scirtothrips dorsalis* in strawberry crops, where specific areas of thrips concentration were identified as dispersal points for the insect, aided by wind currents [1]. Although the gall protects the thrips, precipitation affects the populations by penetrating this structure and drowning or, if necessary, clearing the insects (personal observation, Salas-Araiza).

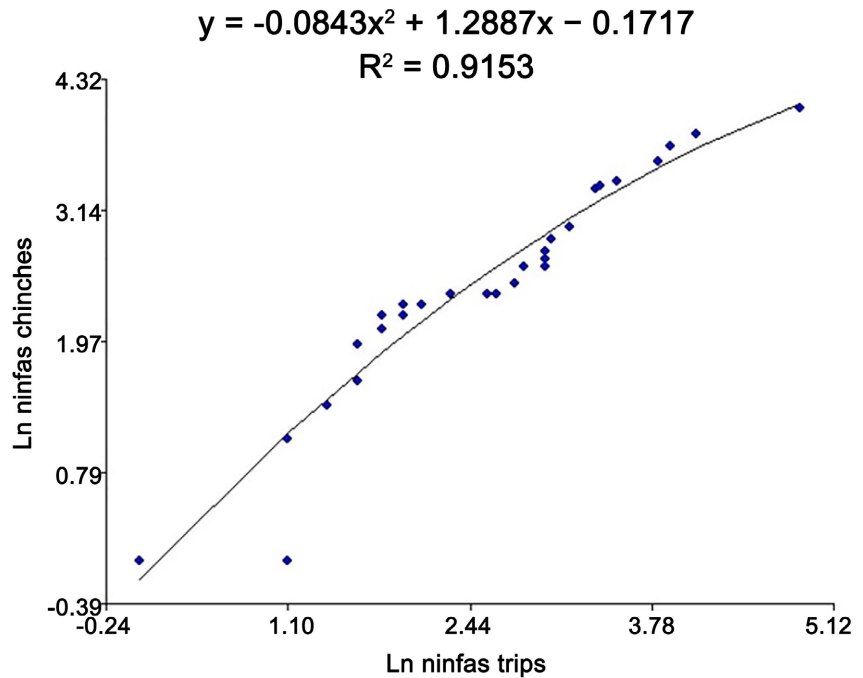


Figure 1. Second-degree polynomial regression between the number of bug nymphs and thrips nymphs on *Ficus* spp. Irapuato, Gto., 2023.

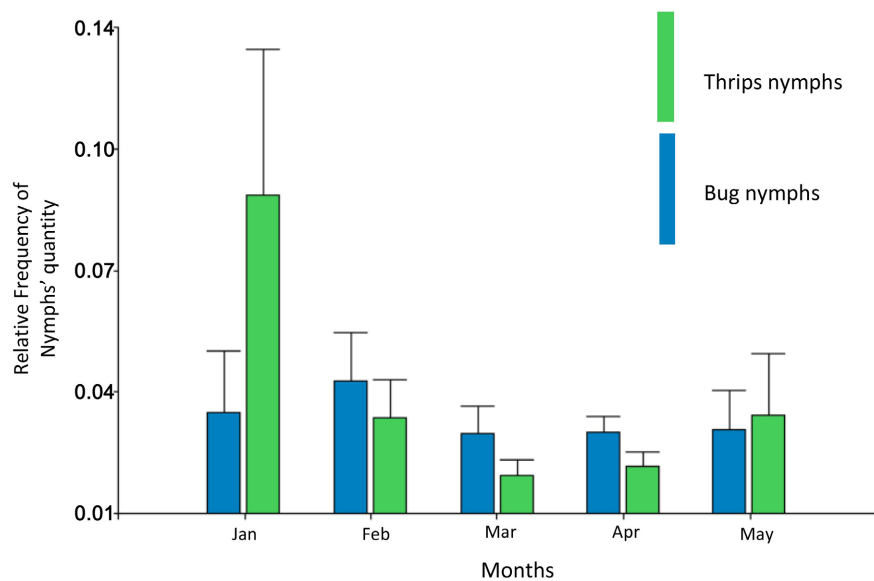


Figure 2. Proportion of the fluctuation of *G. uzeli* and *M. confusa* nymphs throughout the sampling period. Error bars indicate the standard error (SE).

The ANOVA results indicate that there were no significant differences in the average number of bug nymphs, but there were significant differences in the number of thrips nymphs ($F = 3.9$, $p = 0.02$); the highest number occurred in January, and the lowest in March and April (**Table 1**).

Table 1. Monthly fluctuation in the number of nymphs (n: number of data points; mean; standard error).

Monthly Fluctuation of Nymphs		
Month	Thrips	Bug
January	231 (57.7 ± 24.8) a	66 (16.5 ± 8.4) a
February	157 (19.6 ± 6.7) ab	166 (20.7 ± 6.6) a
March	119 (9.9 ± 2.7) b	163 (13.5 ± 3.7) a
April	46 (11.5 ± 2.4) b	55 (13.7 ± 2.2) a
May	81 (20.2 ± 10.4) ab	57 (14.2 ± 5.3) a

Different letters within each column indicate significant differences (Tukey, $p = 0.05$).

3.2. Relationship between adult *G. uzeli* Thrips and *M. confusa* Anthocorids

A total of 5691 thrips adults (177.8 ± 14.2) and 56 bug adults (1.7 ± 0.3) were recorded. The second-degree polynomial regression between the number of bug adults and thrips adults indicated a significant positive correlation ($R^2 = 0.92$, $F = 92.5$, $p < 0.0001$) (**Figure 3**).

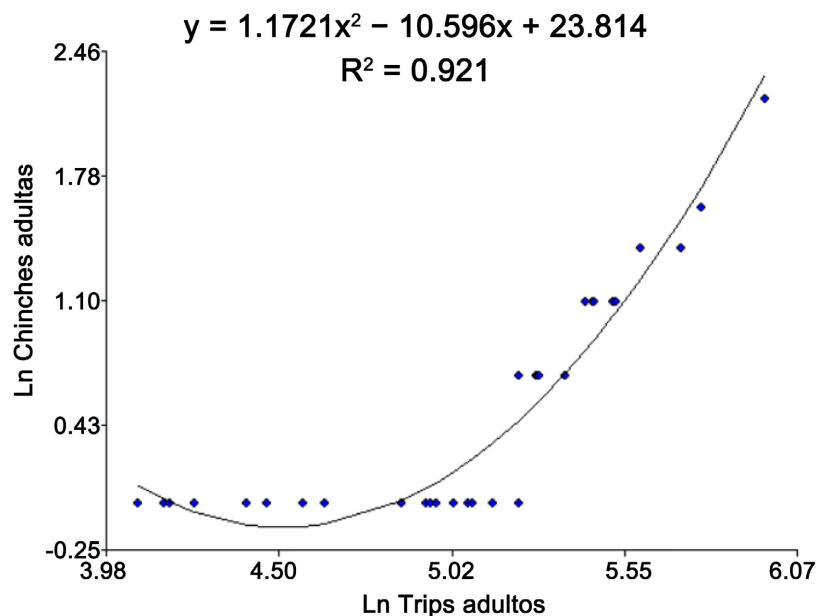


Figure 3. Second-degree polynomial regression between the number of adult bugs and adult thrips.

The number of adult bugs did not differ significantly during the sampling

months, but the number of adult thrips did ($F = 3.3$, $p = 0.02$) (Figure 4); the month with the most adults was February and the lowest was May (Table 1). The results of this study showed only the presence of *M. confusa*, but Cambero-Campos *et al.* [7] also reported *Montandoniola moraguesi* (Hemiptera: Anthocoridae), as well as *Chrysoperla* spp. (Neuroptera: Chrysopidae), *Thripastichus gentilei* (Hymenoptera: Eulophidae), and the predatory thrips *Androthrips* sp.

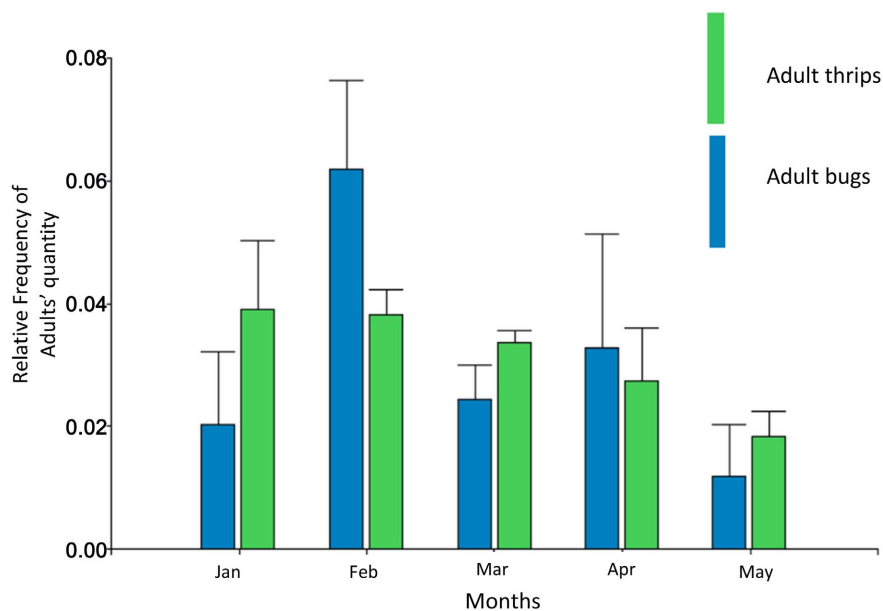


Figure 4. Proportion of the population fluctuation of adult-stage insects throughout the sampling period. Error bars indicate the standard error (SE).

The shape of the gall formed by *G. uzeli* shows a slight opening, making it more susceptible to infestation by predatory insects [3]. Although not the anthocorid species studied here, adults of *Orius similis* (Hemiptera: Anthocoridae) have been reported to prefer first instar nymphs of *Scirtothrips dorsalis* (Thysanoptera: Thripidae) compared to third and fourth instars [14]. However, when comparing the predatory capacity of *O. insidiosus* and *M. confusa*, no differences were found between the two species [15]; both preferentially prey on eggs of *G. uzeli*, noting that females consume more eggs than males. The fecundity of *M. confusa* is higher than that of *O. insidiosus* and can reduce thrips populations by 95% and galls by up to 77% within five weeks.

The development of *M. confusa* shows that Ficus leaves are favorable for its growth, as immatures were more abundant than adults of this predator (Table 1 and Table 2). In this regard, a study indicated that populations of this thrips and its predator generally fluctuate together [4]. Although predatory insects are typically generalists, in this case, this can be debated, as the behavior of the anthocorid is very specific due to its close relationship with *G. confusa*.

During this study, the number of eggs of both species was not recorded. Tavares *et al.* [4] pointed out this predator's preference for eggs; the bug oviposits in lines

parallel to the prey's eggs, suggesting that the preference for eggs is due to their being more nutritious and easier to capture because they cannot escape due to the absence of wings.

Table 2. Monthly fluctuations in the number of adults (n = number of data points; mean; standard error).

Monthly Fluctuation of Nymphs		
Month	Thrips	Bug
January	865 (216.2 ± 68.7)	4 (1.0 ± 0.7)
February	1685 (210.6 ± 25.2)	28 (3.5 ± 0.8)
March	2203 (183.5 ± 11.4)	15 (1.2 ± 0.3)
April	577 (144.2 ± 53.4)	7 (1.7 ± 1.1)
May	361 (90.2 ± 23.9)	2 (0.5 ± 0.5)

Table 3. Total population of thrips and anthocorids in Ficus galls. Irapuato, Gto., Mexico, 2023.

Location	Total Population			
	Thrips Nymphs	Thrips Adults	<i>M. confusa</i> nymphs	<i>M. confusa</i> adults
ITESI	212	2347	129	27
El Copal	422	3317	378	34

The presence of galls decreases during the rainy season; new leaves do not show damage.

The age of the trees in El Copal is greater than at ITESI, but it is unclear whether this influenced the higher population observed at this site; it is possible that thrips prefer mature trees because of their greater resistance to supporting insect populations, compared to young trees that would be weakened by the attack and would have no food for the population to develop (Table 3). The phenology of the plant was not recorded in this work. Oviposition preference varies depending on the phenological stage of the plant species, as it has been reported that the thrips *Frankliniella occidentalis* (Pergande) prefers to oviposit on certain plant species during the vegetative stage, but host preference changes when the plant is flowering [16]. Females of *F. occidentalis* respond strongly to volatiles from flowers of different species, while males show a weaker response [17]. It is possible that colonization of Ficus plants in El Copal is influenced by the scent of some attractant, particularly affecting females. However, this may be due to adaptation processes of individuals in each population and the characteristics of the environment in which they develop, as well as differences in the genetic pool unique to each population [18].

4. Conclusions

The Ficus thrips *Gynaikothrips uzeli* Zimmerman (Thysanoptera) and its predator *Montandoniola confusa* Streito (Hemiptera: Anthocoridae) were identified. It

is concluded that there is a close and specific relationship between these two species on this plant.

The populations of nymphs of both species are very similar; possibly the ease of capturing the prey helps the predator maintain the thrips populations at similar levels, since they cannot escape.

The number of adult thrips notably exceeds the number of predator adults, possibly because the prey's greater ability to escape allows it to develop in larger numbers.

Thrips populations were more abundant at the El Copal site, as was the predator *M. confusa*. It is unclear why, but this may be related to the older age of the trees at this location. Although not included in this study, the presence of galls noticeably decreases on *Ficus benjamina* during the rainy season when young leaves proliferate abundantly.

With these results, pruning activities can be planned primarily in March in the area where this research was conducted, focusing primarily on the outer part of the foliage, since thrips do not penetrate to form galls on mature leaves.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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