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Competition between two biocontrol agents attacking the thrips, *Gynaikothips ficorum* (Marchal) (Thysanoptera: Phlaeothripidae), infesting the Cuban laurel, *Ficus nitida* Thunb., in Egypt

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Abstract

The insect fauna is present in the curled Cuban laurel leaf (*Ficus nitida* Thunb.) infested with the Cuban laurel thrips, *Gynaikothrips ficorum* Marchal (Thysanoptera: Phlaeothripidae), in Giza, Egypt, which included pests, predators, and parasitoids. The present study dealt with the presence of two natural enemies of *G. ficorum*, i.e., the anthocorid predatory bug, *Montandoniella moraguesi* Puton (Hemiptera: Anthocoridae), and the eulophid parasitoid, *Pediobius thysanopterus* Marchal. (Hymenoptera: Eulophidae). Inspection of infested leaves revealed the presence of the thrips and the two natural enemies all year round. Numbers of the thrips showed 2 peaks (9500 and 12,000 individuals/100 infested leaves) in 2016 recorded in March and November, respectively. The associated predatory bug, *M. moraguesi*, occurred in two peaks in March and August by 8000 and 8500 individuals/100 infested leaves, respectively. Meanwhile, the eulophid parasitoid, *P. thysanopterus*, appeared in low population densities and by only one peak in October 2016 and in August 2017. The same trend for populations of the three concerned insect species was found in 2017. Generally, the very low population of the parasitoid resulted from a severe competition through the dominant voracious predator *M. moraguesi* that feeds not only on the thrips but also on the larvae and pupae of *P. thysanopterus* inside their host (*G. ficorum*) nymphs and prepupae.

Keywords: *Ficus nitida*, *Gynaikithrips ficorum*, *Montandoniella moraguesi*, *Pediobius thysanopterus*, Competition, Egypt

Background

Indian laurel trees, *Ficus nitida* Thunb., are widely spread as ornamental and shadow trees in gardens and streets around the world transferred by international trade of ornamental trees (Mound et al. 1995). In the campus area of the Faculty of Agriculture, Cairo University and Damanhur University, Egypt, ficus trees are always found infested by the invasive thrips *Gynaikothrips ficorum* (Marchal) (Phlaeothripidae: Thysanoptera). Morcos (1944) recorded this species for the first time in Egypt, as *G.* (*Phoeothrips*) *ficorum.* When infested, young leaves become curled upwards and folded around the midrib forming a sandwich-like bag functioning as a microhabitat harboring all thrip stages occurring together with their associated natural enemies. Two hemipterans and a chrysopid were reported by Morcos (1944) predating on the thrips' pupae, mentioning that they were too scarce to be of any importance. Other authors in different countries recorded different natural enemies attacking the different stages of *G. ficorum* on *F. nitida*, e.g., the predatory anthocorid bugs *Orius albidipennis*, *O. insidiosus*, and *O. tristicolor* recorded by Lewis (1973), Tawfik and Ata (1973), and Jacot-Guillarmod and Brothers (1986). Tawfik (1968) studied the biology of *Termatophylum insigne* (Termatophylidae) as a predator on adults and nymphs of *G. ficorum.* Burks (1971) and EL-Husseini et al. (2006) recorded the eulophid parasitoid *Pediobius* (*Pleurotropis*) *thysanopterus* Burks on the nymph and pupae of *G. ficorum.* Besides, they recorded the parasitic mite *Adactylidium* sp. (Acarina: Pyemotidae) that was previously recorded by Abreu-Rodriguez (1982) and

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Antonatos et al. (2011) attacking the eggs of *G .ficorum.* Awadallah et al. (1975) recorded *Chrysoperla carnea* Steph. feeding on the nymphs and adults of this thrip species. Meanwhile, *Montandoniella moraguesi* Puton (Hemiptera: Phlaeothripidae) was recorded by Tawfik and Nagui (1965) and Ibrahim et al. (2013) predating on *G. ficorum* in Egypt.

As different predatory and parasitoid species were recorded associated with the Cuban laurel thrips, *G. ficorum* within the infested folded leaves of *F. nitida*, the present study aimed to shed the light on the relationships between this thrip species and its associated main predator, *M. morguesi* and the parasitoid, *P. thysanopterus*, their abundances and their competition in such microhabitat.

Material and methods

At the campus of the Faculty of Agriculture, Cairo University, Giza, Egypt, a weekly sampling of 25 curled/folded leaves was randomly collected from 5 trees (5 leaves/tree) of *F. nitida* from different directions and heights of the trees. The numbers were grouped monthly (/100 leaves) throughout the sampling period from January to December 2016 and 2017 (EL-Husseini et al. 2006). Sampled leaves were transferred to the laboratory in paper bags for inspection under a stereoscope. Numbers of each species were recorded for two seasons: 2016 and 2017. Rate of predation was calculated for the 2 years 2016 and 2017. The stereomicroscope was provided with regulated illumination that did help in locating the parasitoid larvae inside the mobile thrip larvae.

Numbers of nymphs and adults of the predatory bug *M. moraguesi* and larvae, pupae, and adults of the parasitoid *P. thysanopterus*, separately or together inside the same curled *F. nitida* leaf, were identified by the first author and recorded. In case of both bioagents are found in the same leaf or not, each sampled leaf was kept in a Petri dish, furnished with a moistened filter paper to determine the species individuals coming out (thrips, predator, and/or parasitoid) under the laboratory conditions of 25 ± 1.5 °C and 55 ± 5% RH. A digital camera accessed to a computer was used to shoot photos whenever needed.

Results and discussion

Year 2016

As shown in Table 1, the Cuban laurel thrips, *G. ficorum*, as well as the anthocorid predatory bug, *M. moraguesi*, and the parasitoid, *P. thysanopterus*, were found all year round, associated with different developmental stages inside the microhabitat formed by the infested young leaves. When *G. ficorum* infests young *F. nitida* leaves and sucks the sap from the upper leaf surface, the growing leaf rolls itself upwards around the middle rip, forming a flat room with a specific microhabitat inside. Thus, the fauna associated with the thrips also favors such sheltered condition. Populations of the thrips showed 2 peaks in 2016 (9500 and 12,000 individuals/100 infested leaves) recorded in March and September, respectively. By increasing the temperature (30–40 °C) in summer, the number of thrips decreased until August and then increased rapidly in September to record the third peak.

Fig. 1 The third nymphal instar of *M. moraguesi* feeding on pupae of the parasitoid *P. thysanopterus* inside prepupal shell of *G. ficorum*

The anthocorid predatory bug, *M. moraguesi* (nymphs and adults), presented all year in fluctuated numbers related to the numbers of its prey (*G. ficorum*) that was affected by the prevailing temperature in the area being favored by the high summer temperature. Thus, its numbers overwhelmed those of the thrips in the summer from April to August, showing 2 peaks per year (8000 and 8500 individuals/100 leaves) in March and August (Table 1).

Meanwhile, the eulophid parasitoid, *P. thysanopterus*, was also found all year round, but with very low numbers in relation to its host (*G. ficorum*), as presented in Table 1. Taking its alive stages (larvae, pupae, and adults) into consideration, it had only 1 peak (1700 alive individuals/100 infested leaves) in October. Low numbers of the alive parasitoid *P. thysanopterus* in relation to the killed parasitoid individuals by *M. moraguesi* in its nymphal stage inside the larvae of its host (*G. ficorum*) (Fig. 1) could be explained by the high predation rate by the voracious anthocorid

Table 1 Numbers of individuals of *G. ficorum*, *M. moraguesi*, and *P. thysanopterus* (over l00 infested leaves) in the year 2016

Insect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
G. f.	7500	8000	9500	3500	5000	5000	6600	4500	9500	10,000	12,000	6500
M. m.	4000	2000	8000	6500	6500	6000	7000	8500	4500	5500	3000	2500
P. t.	400	300	300	350	400	500	600	1200	1400	1700	800	450

Table 2 Numbers of individuals of *P.thysanopterus* alive and killed by the predatory bug, *M. moraguesi*, over l00 infested leaves of *F. nitida* in the year 2016

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alive	400	300	300	350	400	500	600	1200	1400	1700	800	450
Preyed	650	520	550	560	640	700	950	2100	2900	3000	1500	700
Total	1050	820	850	910	1040	1200	1550	3300	4300	4700	2300	1150
Predation rate	61.9	67.0	64.7	61.6	61.5	58.3	61.2	63.6	64.4	47.0	65.2	60.8

Table 3 Numbers of *G. ficorum*, *M. moraguesi*, and *P. thysanopterus* individuals (over l00 infested leaves) in the year 2017

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
G. f.	7200	8540	9000	3000	6000	4600	5800	4100	8040	9000	11,000	5000
M. m.	1000	2000	7100	5850	5500	4850	6500	6900	4500	5100	2500	1850
P. t.	350	250	260	280	360	450	500	2000	1000	1000	690	380

Table 4 Numbers of individuals of *P. thysanopterus* alive and killed by the predatory bug, *M. moraguesi*, (over 100 infested leaves) in the year 2017

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alive	350	250	260	280	360	450	500	2000	1000	1000	690	380
Preyed	510	500	620	600	580	1100	2100	4500	1950	1900	1450	780
Total	860	750	880	880	940	1550	2600	6500	2950	2900	2090	1160
Predation rate	59.3	66.6	70.4	68.1	61.7	70.9	80.7	69.2	66.1	65.5	69.3	67.2

predator *M. moraguesi* (nymphs and adults) (Tawfik and Nagui 1965) (Table 2). The predation rate ranged between 47 and 67% all year around, suppressing the population of the parasitoid. This was a severe competition between this predator and the parasitoid. The predator not only feeds voraciously on the Cuban laurel thrips, which is the host of the parasitoid (Tawfik and Nagui 1965), but also feeds on the developing parasitoid stages (larvae and pupae) developed inside the nymphs of the thrips. These results are in line with those of EL-Husseini et al. (2006).

Year 2017

Population abundance of *G. ficorum* in the year 2017 is presented in Table 3. It followed the same trend of the year 2016. Thrip numbers showed 2 peaks through the whole year (9000 and 11,000 individuals/infested leaf) recorded in March and November, respectively.

The associated predator, *M. moraguesi*, also occurred around the year. Its numbers showed 2 peaks (7100 and 6900 individuals, nymphs, and adults) in March and August, respectively. Generally, its numbers were lower than in the year 2016. This could be due to the extremely high temperature in the summer of 2017 that reached 40–45 °C during the months from April to August.

The eulophid parasitoid *P. thysanopterus* presented also all year round, but in relatively very low numbers (larvae, pupae, and adults) as seen in Table 3. It had only 1 peak (2000 alive individuals/100 infested leaves) in August. This low population of the parasitoid was strongly related to the dominance of the anthocorid predator, *M. moraguesi*, which competes with the parasitoid by preying on the thrips, the host of the parasitoid, and also the prey of the larvae and pupae of the parasitoid inside the host thrips' bodies.

As shown in Table 4, the predation rate on the parasitoid, in 2017, was higher than in 2016. It ranged between 59.3 in January and 80.7% in July. This could explain the lower population of the parasitoid in 2017 than in 2016. Such results have not been mentioned previously in the literature.

Conclusion

The two natural enemies of the Cuban laurel thrips, *Gynaikothrips ficorum*, i.e., the anthocorid predatory bug *Montandoniella moraguesi* Puton and the eulophid parasitoid *Pediobius thysanopterus* Marchal, were found all year round inside the curled infested *Ficus nitida* leaves. The eulophid parasitoid was recorded in very low population densities, resulting from a severe competition through the dominant voracious predator *M. moraguesi* that feeds not only on the thrips, but also on the larvae and pupae of *P. thysanopterus* inside their host (*G. ficorum*) nymphs and prepupae.

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