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Article

Effects of leaf domatia on intraguild interactions between *Amblyseius swirskii* and *Phytoseiulus persimilis* (Acari: Phytoseiidae)

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ABSTRACT

Leaf domatia as a habitat-produced structure is considered to moderate the interaction intensity among guild parties. We studied whether domatia of sweet pepper (*Capsicum annum*) leaves could reduce the adverse effects of predation of a phytoseiid on behalf of an intraguild predatory mite on a phytoseiid intraguild prey, and a tetranychid extraguild prey. In the domatia-provided treatments where *Amblyseius swirskii* (Athias-Henriot) females were considered as predator, significantly fewer *Phytoseiulus persimilis* Athias-Henriot juveniles were killed, and eaten in comparison with the treatments without domatia. The predation rate of *A. swirskii* was affected by the domatia *i.e.* the number of eaten *P. persimilis* was significantly lower on patches with four domatia rather than those with no domatium, however, no significant difference was observed between those in patches with two, and four domatia. Both natural, and artificial domatia could reduce the predation rate on *P. persimilis* juveniles. When *P. persimilis* females were considered as predators, the number of *A. swirskii* killed juveniles was affected neither by presence nor by the number of leaf domatia. The number of eaten *Tetranychus urticae* Koch eggs/larvae in patches with either of the intraguild predator species was not affected by the presence, the number, and the type of domatia. We suggest that leaf domatia could affect the survival of phytoseiid predatory mites as the guild participants even when the highly aggressive intraguild predator, *A. swirskii*, enters such structures.

KEY WORDS: *Capsicum annum*; intraguild predation; juveniles; plant structure; predator-prey interaction.

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INTRODUCTION

According to the niche concept, neighboring species usually have negative impacts on one another, so that rarely two species can occupy the same niche (Higashi 1993). Inclusion of facilitation into niche theory leads to positive encounters between niche participants, which could cause harm to neither (Bruno *et al.* 2003). Through these ubiquitous interactions, one individual makes the environment more beneficial for the other (Stachowicz 2001). Habitat structure is one of those facilities which could decrease predation risk through providing refuges, and shelters for the counterattacked individuals (prey) (Klecka 2014). Several studies have demonstrated that the habitat structures could weaken the undesirable effects of intraguild predators on their intra/extraguild preys (Ferreira *et al.* 2008; Schmidt *et al.* 2009; Klecka 2014).

Plant surfaces exhibit a complicated microenvironment useful not only in defensive strategies

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against herbivores but also as a modifier of complex interactions between herbivores, and their natural enemies (Norton *et al.* 2000; Peterson *et al.* 2016; Zhang *et al.* 2016). Leaf domatium is considered a specialized plant trait, mostly in vein axis, providing a shelter for predatory mites (Marjorie *et al.* 2016). These structures vary from simple tufts of hair to packet-like plant tissues on the underside of the leaf (O'Dowd and Willson 1991; Richards and Coley 2012). Predatory mites in return protect plants from herbivorous arthropods through consuming/killing them. The benefits of leaf domatia against herbivores was reported for the first time by Romero and Benson (2004). The possible role of leaf domatia as buffer for predator-prey oscillations on *Cinnamomum camphora* L. (Lauraceae) was suggested by Kasai *et al.* (2002). Domatia mediated mutualism between beneficial mites (e.g. phytoseiids), and plants have also been reported in some other previous studies (Norton *et al.* 2000, 2001; Romero and Benson 2004; Maleknia *et al.* 2016).

Few studies have demonstrated that domatia presence could shape the consequence of critical interactions within a guild: Ferreira *et al.* (2011) also noted that domatia could reduce the interaction intensity of IGP (intraguild predation), resulting in increased survival of both the intra/extraguild predators. Prado *et al.* (2015) have underscored the effect of domatia on predator-predator interactions as well as the predator-prey. They demonstrated that when the domatium was absent, the contribution of the intraguild prey to extraguild prey would decline significantly. Pozzebon *et al.* (2015) suggested that domatia presence could significantly promote the coexistence of *Typhlodromus pyri* Scheuten, and *Amblyseius anderersoni* (Chant), and their oviposition rates on grape (*Vitis vinifera* L.). The intraguild predation (IGP) possesses a considerable potential to affect the population dynamics in the context of biological control (Fonseca *et al.* 2017), thus regarding the impact of domatia on IGP among released phytoseiid species could be a matter of considerable debate.

Amblyseius swirskii (Acari: Phytoseiidae) is an important biological control agent (Guo *et al.* 2016) with easy mass rearing procedures (Calvo *et al.* 2015), and high rate of population increase (Guo *et al.* 2016). *Amblyseius swirskii* is a native mite to the east, and southeast Mediterranean regions (Middle East), but its successful function especially on whitefly, and thrips has promoted its introduction to greenhouses in many countries including Iran. According to Buitenhuis *et al.* (2010), the ability to control coincidence of several pest species could be an important advantage of using *A. swirskii* as a predator. *Phytoseiulus persimilis* (Athias-Henriot) (Acari: Phytoseiidae) as one of the most important biological control agents, is usually a member of natural guilds of plant-inhabiting predatory mites (Walzer and Schausberger 2012). The stability of *P. persimilis*, a specialist predator of tetranychid mites, highly depends on prey availability, therefore prey scarcity would lead to predator disappearance (Çakmak *et al.* 2006). Hence, recent research has been focused on the combined introduction of this species with other phytoseiid predators (Çakmak *et al.* 2006).

Here, we have investigated whether a guild with *A. swirskii* as IG predator, *P. persimilis* as IG prey, and *Tetranychus urticae* Koch as extraguild prey established on domatia-equipped patches would suffer from less intraguild predation effects.

MATERIAL AND METHODS

Plants, and mites

Bean plants (*Phaseolus vulgaris* L.) were used as rearing system and sweet pepper plants were used for domatia experiments. We used seedling trays (72–100 Cells) with moist peat pellets to plant pepper [*Capsicum annum* L. (Solanaceae)] seeds under controlled conditions (25 ± 5 °C, 16L: 8D photoperiod, $65 \pm 5\%$ RH) at the Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran. One seed was planted per cell by laying the seeds on the top of the pellet, and gently pressing it in. Making sure the seed was covered with pellet, trays were watered from the bottom so that the pellet kept moist during seed germination (about 10 days). Fertilizer solution of NPK (20 × 20 × 20) was added to the trays once every two days.

We grew common bean plants (*Phaseolus vulgaris* L. (Fabaceae) var. Red Alamouti) in plastic pots in a greenhouse (soil: perlite; 50: 50%) at the same department under controlled conditions (25 ± 5 °C, 16L: 8D photoperiod, 65 ± 5 % RH). Plants were watered daily with tap water, and a fertilizer solution of NPK (20 × 20 × 20). Spider mites, *Tetranychus urticae* Koch (green form) were reared on bean plants to be used as food source for the predatory mites. Fresh bean plants were added to the rearing system regularly.

The predatory mites, *A. swirski*, and *P. persimilis* were separately reared on masses of detached bean leaves, infested with *T. urticae*, placed upside down on a plastic sheet on a water-saturated sponge. The plastic sheet was surrounded by napkin tapes that were put into the water from opposite side to provide humidity. Fresh *T. urticae* infested leaves were added to the rearing system, and the old predator-free leaves were removed regularly. The cultures were kept in separate growth chambers under controlled conditions (25 ± 1 °C, 16L: 8D photoperiod, 65 ± 5 % RH) in the Acarology laboratory at Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran. To reduce the host plant shift effects, the predators were transferred to spider mite-infested sweet pepper detached leaves (prepared same as above) three generations before experiments. All the experiments were performed under controlled conditions mentioned above.

Experimental procedure

The effect of domatia presence on the predation rate of IG predator on IG prey

To assay the effect of domatia presence on the predation rate of IG predator on IG prey, we prepared 2.5×2.5 cm pepper leaf squares (with, and without domatia) put upside down in a Munger cell consisting of one 7 mm thick Plexiglas piece (5×10 cm) with a hole (2.5 cm in diameter) in the middle which was covered with 2 mm thick glass pieces (5×10 cm) fixed on both sides. The leaf squares, which were considered as patches without domatia (Control), were collected from those leaves that naturally possessed no domatia. In those squares, which were considered as domatia-possessed ones, the number of domatia were reduced to 3 (Razi glue drops, Razi industrial Group, Iran), so that the effect of domatia number was eliminated. In order to omit the effect of glue (odor) on the predator behavior, the same number of glue drops (one for each domatia) were put on the control groups. A young (five-day-old) female *A. swirskii* (IG predator) was put into the Munger cell (on the leaf) along with seven same-aged (24 hours) *P. persimilis* larvae (IG prey). We checked the IG prey larvae status (killed, alive) after 10 hours. The experiment was performed with 15 replicates. The replicates, in which either the prey, or the predator were lost (left the patch), were eliminated from the experiment. Female predators were chosen from the young ovipositing same-aged ones. The same experimental procedure was performed with *P. persimilis* females as IG predator in coincidence with seven *A. swirskii* same-aged larvae as IG prey.

The effect of domatia presence on the predation rate of IG predator on T. urticae eggs/larvae

In order to study the effect of domatia presence on the predation rate of *T. urticae* eggs/larvae, similar experimental units were prepared. Five same-aged *T. urticae* larvae plus five same-aged *T. urticae* eggs were introduced to each Munger cell. After 10 hours the number of *T. urticae* eaten eggs/larvae were recorded. The experiment was performed with 15 replicates.

The effect of domatia type on the predation rate of IG predator on IG prey

To assess the effect of domatia type (natural/artificial) on the predation rate of IG predator on IG prey, we used Petri dishes (9 cm in diameter) with a pepper leaf disk (3×3 cm) in the middle put upside down on a water saturated sponge (3×3 cm). Leaves that naturally possessed domatia were considered as treatments with natural-domatium types. To prepare the leaves with artificial-type domatia, we chose those pepper leaves that naturally possessed no domatium within the plant.

Similar-sized leaf squares were prepared as above. Seven to 10 white tiny cotton threads (3 cm in length) were added to the (four) axils of the major vein with minor ones on the leaf underside mimicking the natural domatia. A female *A. swirskii*/*P. persimilis* (five hours old) as the IG predator, along with five same-aged (24 hours old) *P. persimilis*/*A. swirskii* larvae as IG prey, and *T. urticae* juveniles (five eggs plus five larvae) as extraguild prey were introduced to each Petri dish. After 10 hours, the number of eaten IG prey larvae, and the number of *T. urticae* eaten eggs, and larvae were recorded. The replicates, in which either the prey, or the predator were lost (left the patch), were eliminated from the analysis. Female predators were chosen from the young ovipositing same-aged (five hours old) ones. The experiment was performed with 15 replicates.

The effect of domatia number on the predation rate of IG predator on IG prey

To assay the effect of domatia number on the predation rate of IG predator on IG prey, we used Petri dishes (9 cm in diameter, with 0, two, and four domatia) with a pepper leaf disk (3 × 3 cm) in the middle, put upside down on a water saturated sponge (3 × 3 cm). The leaf squares with four domatia were cut, and prepared from almost similar sized pepper leaves with similar midrib, and domatia locations. Those with two domatia were prepared the same, by adding glue drops in order to close two of the (four) open domatia. Those with 0 domatia were chosen from the leaves which naturally possessed no domatia. Care was taken to add four, and two glue drops near (not on) the domatia of those patches with 0, and two domatia, respectively in order to eliminate the effect of glue odor. The detached leaf squares (with 0, two, and four domatia) here, were all prepared from the same-aged leaves of the plants; their age differed from those in the first experiment (presence, or absence of domatia), so that the experiment with no domatia needed to be repeated in this experiment. A female *A. swirskii*/*P. persimilis* (five hours old) as the IG predator, along with five same-aged (24 hours old) *P. persimilis*/*A. swirskii* larvae as IG prey, and *T. urticae* juveniles (five eggs plus five larva) as extraguild prey were introduced to each Petri dish. After 10 hours, the number of eaten IG prey larvae, and the number of *T. urticae* eaten eggs, and larvae were recorded. The replicates, in which either the prey, or the predator were got lost (left the patch), were eliminated from the analysis. The experiment was performed with 15 replicates.

Data analysis

Data was analyzed using independent t test, after confirming the normality to assay the effect of domatia presence, and also the effect of domatia type on the predation rate of the predator. The effect of domatia number on the predation rate of the predator was assessed through one-way ANOVA followed by Tukey HSD post hoc test. All analyses were conducted in SPSS ver. 25.

RESULTS

The effect of domatia presence on the predation rate of IG predator on IG prey

Our results showed that the predation rate of *A. swirskii* on *P. persimilis* larvae was significantly less on the leaves with domatia ($P < 0.05$) (Table 1). Although we were aware of *P. persimilis* specific diet (*Tetranychus urticae*), and its very low probability of killing heterospecific (*A. swirskii*) larvae. We needed to repeat the same experiment with *P. persimilis* females as predator and *A. swirskii* larvae as prey in order to be able to make further comparisons. Interestingly, when *P. persimilis* was considered as IG predator, few injured, and killed *A. swirskii* larvae were recorded from both patch types, but no significant difference was recorded between its predation rate on the patches with, and without domatia ($P > 0.05$) (Table 1).

The effect of domatia presence on the predation rate of IG predator on T. urticae eggs/larvae

When *A. swirskii*/*P. persimilis* females were introduced as the IG predator, no significant difference was recorded between the number of eaten *T. urticae* eggs/larvae in patches with, and

without domatia ($P > 0.05$) (Table 2).

Table 1. Average number (\pm SE) of *Amblyseius swirskii*/*Phytoseiulus persimilis* eaten (killed) larvae after 10 hours on the patches with/without domatia.

Predator species	Total number of IG prey larvae		Eaten IG prey larvae (mean \pm SE)		P-value*
	Domatia present	Domatia absent	Domatia present	Domatia absent	
<i>A. swirskii</i>	7	7	3.66 \pm 0.31	4.93 \pm 0.37	< 0.05
<i>P. persimilis</i>	7	7	0.20 \pm 0.10	0.06 \pm 0.04	> 0.05

* $d_f = 12$

Table 2. Average number (\pm SE) of *Tetranychus urticae* eaten (killed) eggs/larvae after 10 hours on the patches with/without domatia.

Predator species	Eaten <i>T. urticae</i> eggs (mean ± SE)		P-value	Eaten <i>T. urticae</i> larvae (mean ± SE)		P-value
	Total n = 5			Total n = 5		
	Domatia present	Domatia absent		Domatia present	Domatia absent	
<i>A. swirskii</i>	3.21 ± 0.21	3.07 ± 0.26	> 0.05	1.85 ± 0.17	2.14 ± 0.20	> 0.05
<i>P. persimilis</i>	2.28 ± 0.22	2.78 ± 0.18	> 0.05	3.12 ± 0.61	2.62 ± 0.71	> 0.05

The effect of domatia type (natural/artificial) on the predation rate of IG predator on IG prey

When *A. swirskii*/*P. persimilis* females were introduced as the IG predator, no significant difference was recorded between the number of eaten prey larvae in patches with natural domatia and with artificial ones ($P > 0.05$) (Table 3).

Table 3. Average number (\pm SE) of *Amblyseius swirskii*/*Phytoseiulus persimilis* eaten (killed) larvae after 10 hours on the patches with natural/ artificial domatia.

Predator species	Total number of IG prey larvae		P-value	Eaten IG prey larvae (mean \pm SE)		P-value
	Natural domatia	Artificial domatia		Natural domatia	Artificial domatia	
<i>A. swirskii</i>	7	7		2.86 \pm 0.27	2.60 \pm 0.37	> 0.05
<i>P. persimilis</i>	7	7		0.13 \pm 0.09	0.13 \pm 0.09	> 0.05

The effect of domatia type (natural/artificial) on the predation rate of IG predator on T. urticae eggs/larvae

When *A. swirskii* was introduced as IG predator, no significant difference was observed between the number of *T. urticae* larvae predated on patches with natural domatia in comparison with those having artificial domatia ($P > 0.05$). The similar observation was made about the number of *T. urticae* predated eggs ($P > 0.05$) (Table 4).

Table 4. Average number (\pm SE) of *T. urticae* eaten (killed) eggs/larvae after 10 hours on the patches with natural/artificial domatia.

Predator	Eaten <i>T. urticae</i> eggs (mean ± SE)		P-value	Eaten <i>T. urticae</i> larvae (mean ± SE)		P-value*
	Total n = 5			Total n = 5		
	Natural domatia	Artificial domatia		Natural domatia	Artificial domatia	
<i>A. swirskii</i>	4.06 ± 0.28	4.20 ± 0.24	> 0.05	3.33 ± 0.41	2.93 ± 0.26	> 0.05
<i>P. persimilis</i>	3.09 ± 0.26	3.60 ± 0.36	> 0.05	2.86 ± 0.30	2.93 ± 0.30	> 0.05

* $d_f = 12$

When *P. persimilis* was introduced as IG predator, no significant difference was observed between the number of *T. urticae* larvae predated on patches with natural domatia in comparison with those possessed artificial domatia ($P > 0.05$). The similar observation was made on the number of *T. urticae* predated eggs ($P > 0.05$).

The effect of domatia number on the predation rate of IG predator on IG prey

When *A. swirskii* was introduced as the IG predator, a significant difference was observed among the number of IG prey larvae on patches with 0, two, and four domatia (ANOVA, $F = 7.95$, $P < 0.01$). The predation rate (mean \pm S.E.) on patches with two domatia was significantly higher than that on patches with no domatia (2.40 ± 0.25 vs. 1.10 ± 0.29 , Post-hoc Tukey HSD, $P < 0.01$). No significant difference was observed between the number of larvae eaten on patches with two domatia in comparison with that of patches with four domatia (2.40 ± 0.25 vs. 2.80 ± 0.26 , Post-hoc Tukey HSD, $P > 0.05$).

When *P. persimilis* was introduced as the IG predator, few *A. swirskii* larvae were attacked and killed, so that no significant difference was observed among the number of IG prey larvae on patches with 0 (0.13 ± 0.09 larvae), two (0.13 ± 0.09 larvae), and four (0.53 ± 0.21 larvae) domatia (Descriptive analysis, $F = 2.54$, $P > 0.05$).

The effect of domatia number on the predation rate of IG predator on T. urticae eggs/ larvae

Although we were aware of not-significant effect of domatia presence on the predation rate of predator on *T. urticae* eggs/larvae (experiment one), we would rather consider patches with no domatia again, parallel with that performed above. When *A. swirskii* was introduced as IG predator, no significant difference was observed among the mean (\pm SE) number of *T. urticae* eggs predated on patches with 0 (4.20 ± 0.36 eggs), two (3.60 ± 0.41), and four (4.40 ± 0.25) domatia ($P > 0.05$). The similar observation was made about the mean (\pm S.E.) number of *T. urticae* predated larvae (2.37 ± 0.49 , 2.86 ± 0.35 , 4.40 ± 0.25 larvae, respectively, $P > 0.05$). When *P. persimilis* was introduced as IG predator, no significant difference was observed among the mean (\pm SE) number of *T. urticae* eggs predated on patches with 0 (4.50 ± 0.16 eggs), two (4.66 ± 0.18), and four (4.33 ± 0.33) domatia ($P > 0.05$). A similar observation was made about the mean (\pm S.E.) number of *T. urticae* predated larvae (3 ± 0.27 , 2.80 ± 0.29 , 3.46 ± 0.21 larvae, respectively, $P > 0.05$).

DISCUSSION

Several studies have demonstrated that domatium as a sheltered place could enhance the potential of *A. swirskii* for distribution, and foraging (Romero and Benson 2005; Shimoda *et al.* 2017). Kumar *et al.* (2015) also have reported an apparent influence of domatia presence on *A. swirskii* population on pepper plant. Meanwhile, only a few reports have focused on whether such habitat structure could affect the frequency of IGP when both predator species tend to use the provided refuge (Ferreira *et al.* 2011; Pozzebon *et al.* 2015). The data presented here, confirmed that domatia could also offer protection from intraguild predation for *P. persimilis* larvae when *A. swirskii* is considered as the intraguild predator. This could be due to the higher presence rate of *P. persimilis* larvae in domatia in comparison with that in *A. swirskii* adults, which is in line with McMurtry *et al.* (2013) who categorized *A. swirskii* as a smooth-bodied predator, which tends to inhabit smooth parts of the leaf. Our finding contrasts with Croft *et al.* (2004) who reported that generalist phytoseiids might be provided with more diverse mechanisms *i.e.* spending more time in domatia, in order to overcome the stressed biotic, or abiotic environment. Although their research did not include any direct information about *A. swirskii*. Kreiter *et al.* (2003) noted that the generalist type III phytoseiid predator, *Kampimodromus aberrans* (Oudemans) (same type as *A. swirskii*), occurred more frequently on plants with special leaf characteristics *i.e.* trichomes, and domatia, obviously different from our records. Shimoda *et al.* (2017) have also demonstrated that commercial moisturized

sheltered places of leaf could potentially be useful for *A. swirskii* release efficiency, but they did not imply that “domatia” would elicit an absolute effect on such a species. Our data showed that despite *A. swirskii* high aggressiveness (Guo *et al.* 2016), domatia presence could lead to much more modulated IGP interactions. The different behaviour reported from *A. swirskii* in our research, might be due to the effect of strong intraguild interactions, which were absent in researches mentioned above. The reason of *A. swirskii* less tendency toward presence in domatia, which also is influenced by other phytoseiid species needs to be more investigated.

The number of eaten *T. urticae* eggs/larvae did not differ between the patches with, and without domatia in the presence of either *A. swirskii*, or *P. persimilis* as intraguild predators. This contrasts with Romero and Benson (2004, 2005), and Kasai *et al.* (2002) who discussed the association between the leaf domatia, and herbivore stabilization. They suggested that domatia would reduce the risk of predator extinction by means of increasing predator-prey oscillation. The different result here, might be due to the unpredicted higher presence rate of intraguild prey (*P. persimilis/A. swirskii*) which led to higher contact rates between either of the predators with *T. urticae* eggs/larvae. If the presence of domatia had not been resulted in the significant higher presence rate of IG prey, then a higher *T. urticae* survival rate would be expected.

Comparing the rate of intraguild predation within natural, and artificial domatia, we recorded no significant difference, *i.e.* in both domatia types, *A. swirskii* adults fed on less *P. persimilis* larvae, and vice versa. According to Nishida *et al.* (2005), anatomical differences among domatia types lead to their different ecological applications for arthropods. We did our best to provide the artificial domatia with the most similarity not only with the natural ones but also within the replicates. Therefore it seems that the use of mimicking materials could also be an appropriate approach in order to reduce IGP negative effects, besides choosing naturally domatia harboring host plants. Our results paralleled with Bresch *et al.* (2019), who demonstrated that rose plants with artificial domatia were sufficiently desirable for *Neoseiulus californicus* to settle, and oviposit on. Similarly, Loughner *et al.* (2011) showed that adding acrylic fibers on the canopy of plants could increase the oviposition rate of *A. swirskii*. To our knowledge, this is the first record of decreased IG predator interaction rate with IG prey when the host is provided with artificial domatia. The number of eaten *T. urticae* eggs/larvae did not differ between the patches with natural, and artificial domatia in the presence of either *A. swirskii*, or *P. persimilis* as intraguild predators. It seems that, as changing the type of domatia (mentioned above) did not affect the distribution pattern of *A. swirskii*, and *P. persimilis*, the interaction intensity between either predator species with *T. urticae* was not affected either.

Comparing the rate of *A. swirskii/P. persimilis* predation on *P. persimilis/A. swirskii* larvae on leaf patches having two, and four domatia, showed no significant difference. Because of the pepper leaf's small size, we were not able to increase the number of natural domatia per leaf disc. Also, in order to focus on the domatia effects beside other variables, we had to use detached leaves rather than whole plant. It seems that although the domatia presence could significantly reduce the rate of killed intraguild larvae, its doubling could not increase the predation rate. This result is similar with those found by Parolin *et al.* (2015) who demonstrated that the number of available domatia on *Vitis* species as host plants could not affect the predatory mites, *N. californicus*, and *P. persimilis*, presence rate. The predator individual distribution in the treatments with four domatia, seemed heterogeneous (personal observations) which means either the predator had occupied the first domatia it found, or impressed with the abiotic conditions *i.e.* temperature, humidity, and position related to each domatia (Situngu and Barker 2017). Our results also showed that the number of eaten *T. urticae* eggs/larvae did not differ between the patches with two, and four domatia which could be expected from the unchanged distribution of the predatory mites within domatia.

The present study confirms the hypothesis that domatia presence could modify the interactions among the members of a guild, in which IG predator, and prey both are related to the family Phytoseiidae. Both natural, and artificial domatia reduced the rate of eaten IG prey even when the highly aggressive *A. swirskii* adults were chosen as predators, thus the negative effect of IGP could

be decreased when both IG predator, and prey species are of noteworthy phytoseiids. It remains to be investigated whether increasing the number of domatia, e.g. considering the whole plant as the experimental unit, could influence the predation rate of intra/extra guild prey. To the best of our knowledge, the present study is the first to document a generalist, and specialist predatory mite behavior through a guild impressed by domatia status. Further experiments are needed to explore unknown aspects of plant structures on predator-prey interactions.

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تأثیر دوماتیای برگی بر برهم‌کنش‌های درون رسته‌ای بین *Amblyseius swirskii* و *Phytoseiulus persimilis* (Acari: Phytoseiidae)

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چکیده

دوماتیای برگی به عنوان ساختاری زیستگاهی، موجب تعدیل شدت برهم‌کنش‌های بین افراد تشکیل دهنده رسته می‌شود. در این پژوهش به بررسی این موضوع پرداخته شد که آیا دوماتیای برگی گیاه فلفل شیرین (*Capsicum annum*) می‌تواند مضرات شدید شکارگری از سوی یک گونه شکارگر درون رسته را بر شکار فیتوزئید درون‌رسته و کنه تترانیکید به عنوان شکار برون‌رسته کاهش دهد؟ در تیمارهای واجد دوماتیا که *Phytoseiulus* در آن نقش شکارگر را برعهده داشت، تعداد زاده‌های کشته و خورده شده *Amblyseius swirskii* (Acari: Phytoseiidae) در مقایسه با تیمارهای بدون دوماتیا به‌طور معنی‌داری کاهش یافت. میزان شکارگری *A. swirskii* هم تحت تأثیر دوماتیا قرارگرفت به نحوی که تعداد *P. persimilis* خورده‌شده، روی پچ‌های دارای چهار دوماتیا و در مقایسه با این تعداد در پچ‌های بدون دوماتیا به‌طور معنی‌داری کم‌تر بود، این درحالی است که تفاوت معنی‌داری بین این تعداد در پچ‌های دو و چهار دوماتیا دیده نشد. میزان شکارگری روی *P. persimilis* در هر دو نوع پچ دارای دوماتیای طبیعی و مصنوعی با کاهش مواجه شد. هنگامی که *P. persimilis* به عنوان شکارگر در نظر گرفته شد، تعداد زاده‌های کشته شده *A. swirskii* تحت تأثیر هیچ‌یک از عوامل تعداد و نوع دوماتیا قرار نگرفت. تعداد تخم/لارو خورده‌شده *Tetranychus urticae* Koch (Tetranychidae) در پچ‌های حاوی هریک از گونه‌های شکارگر، تحت تأثیر وجود، تعداد و نوع دوماتیا قرار نگرفت. به‌نظر می‌رسد دوماتیای برگی روی میزان زنده‌مانی کنه‌های شکارگر فیتوزئید به عنوان اعضای یک رسته تأثیر می‌گذارد و این ویژگی حتی در صورت حضور شکارگر بسیار مهاجم *A. swirskii* در دوماتیا هم برقرار است.

واژگان کلیدی: گیاه فلفل شیرین؛ شکارگری درون‌رسته‌ای؛ زاده‌ها؛ ساختار گیاهی؛ برهم‌کنش شکارگر-شکار.

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