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Do Two Predatory Candidates Have the Ability to Restrict Some Piercing and Sucking Pests on Rose Bushes in Egypt?

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ABSTRACT

The effectiveness of the indigenous predatory mite, *Euseius plumerii* Abo-Shnaf & Romeih sp. n. and the predacious insect, *Chrysoperla carnea* (Stephens) was measured to suppress the populations of *Tetranychus urticae* Koch, *Macrosiphum rosae* (Linnaeus), *Frankliniella occidentalis* (Pergande) and *Bemisia tabaci* (Gennadius) throughout the period 2006 to 2008. An experiment was done on rose plants (*Rosa hybrida*) cv. 'Huddly' in about one feddan (4000 m^2) at the Orman botanical garden, Giza governorate by using a rate of 1 of each predator to 5 prey of *T. urticae*. As a result, both cited predators reduced all stages of *T. urticae*. At the same time, the predatory insect decreased the populations of the other insect pests, but the situation was reversed by the predatory mite, as it failed to reduce their numbers.

Keywords: aphids, biological, control, mites, population, thrips, whiteflies

INTRODUCTION

This work aimed to assess the potential of two agents, *Euseius plumerii* Abo-Shanf & Romeih (Acari: Phytoseiidae) and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) in controlling some pests, *Tetranychus urticae* (Koch) (Acari, Tetranychidae) and three sucking insect pests [aphid, *Macrosiphum rosae* (Linnaeus), Western flower thrips (WFT), *Frankliniella occidentalis* (Pergande) and whitefly, *Bemisia tabaci* (Gennadius)] on cut-flower rose plants at Giza Governorate.

Rose plants are often damaged by high densities of tetranychid mites. The two-spotted spider mite, *T. urticae* is considered as one of the most important pests of roses in greenhouses (van de Vries 1985; Jiang 1985; Vacante 1985; Pasini *et al*. 1999).

Chemical control is the main method of combating spider mites, but due to its associated problems as resistance and environmental pollution, biological control has been tried as an alternative method. Several species of natural enemies have been reported as prey on spider mites and studies have been conducted to assess its potential in controlling the pest (Opit *et al*. 2005).

Phytoseiid mites are worldwide predators involved in the biological control of phytophagous mites of various crops (McMurtry and Croft 1997). Many predatory mite species were released by several authors to control mite pests on certain plants (El-Sayed 2003; Opit *et al*. 2004; Ali *et al*. 2005; El-Gobashy 2006).

Phytoseiulus persimilis Athias-Henriot is a widely used phytoseiid mite with success and is commercially available. However, in Mediterranean countries, it is not commonly found as it is not well adapted to the prevailing climatic conditions. Therefore, the lack of successful control of *T. urticae* in warmer areas has resulted in a search for predators that are adapted to such climatic conditions (Prasad 1967; Shih *et al*. 1979). Cakmak *et al*. (2009) investigated whether combined releases of *P. persimilis* and *Neoseiulis californicus* (McGregor) provide better biological control of *Tetranychus cinnabarinus* (Boisduval) on strawberry than releases of each predator species alone.

The predatory mite, *Euseius plumerii* was described as a new species by Romeih *et al*. (2010) and had been reported to attack different stages of *T. urticae* on rose bushes at Giza governorate, in addition to its adaptation to Egyptian environmental factors (Abo-Shnaf 2009).

Green lacewings are considered to be one of the most effective generalist predators (New 1975), feeding on aphids, spider mites, scales, psylla, mealybugs, whiteflies, thrips, leafhoppers, and other soft-bodied prey (Canard *et al*. 1984; New 1988). *C. carnea* is used in augmentative programmes to control spider mites (Lo *et al*. 1989; Pal *et al.* 1989; Sharanabasava and Manjunatha 1998a, 1998b; Reddy 2001, 2002). The effectiveness of the common green lacewing, *C. carnea* in sustainable biological control programmes on *B. tabaci* was discussed (Syed *et al*. 2005; Zia *et al*. 2008).

MATERIALS AND METHODS

An experiment was conducted during two growing seasons (2006-2007) and (2007-2008) on one of the most important rose cultivar for export, 'Huddly', at Orman Botanical Garden, Giza governorate. At the beginning of January, the plants were pruned.

Mass rearing of the predatory mite, *Euseius plumerii*

A native strain of *E. plumerii* originating from Orman Botanical Garden, after confirming their predation, was reared continuously on fresh beefsteak leaves (*Acalypha wilkesiana*) raised on moistened cotton with water in plastic trays (20 cm diameter and 3 cm high) and provided with enough individuals of *T. urticae* at different stages under controlled conditions of 25 ± 2°C and 70 ± 5% RH.

Release of the predatory mite, *Euseius plumerii*

Predator release was carried out using beefsteak leaves harbouring known numbers of predatory mite, kept separately in polyethylene bags tightly closed with rubber bands, then put in ice box until reaching the rose bushes. The release was carried out 1-2 h before sunset. When the density of *T. urticae* had reached 4-5 individuals

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per leaf (active stages), *E. plumerii* was released at the rate of 1 predator to 5 prey by hanging the polyethylene bags between rose leaves. *E. plumerii* was released once per season started on July 15, 2006 and 2007. The total level of *E. plumerii* was calculated using the formula edited by Çakmar *et al*. (2005) as the following:

The total level of predatory mites = (T×L×P) / R

where T = No. of *T. urticae*/leaf, L = No. of leaves/plant and P = No. of plants in plot R = the ratio of release.

Release of the predatory insect, *C. carnea*

C. carnea was released to control *T. urticae* when its numbers reached 4-5 individuals per leaf. The ratio between predator and prey was 1:5. In addition to the above prey, it can control some other pests: *M. rosae*, *F. occidentalis* and *B. tabaci* (Jin 1986; Sengonça *et al*. 1987; Butler and Henneberry 1988). The predator, *C. carnea* was released by placing small cups containing known numbers of 2nd instars of *C. carnea*; these cups were placed in an ice box until release, which was carried out 1-2 h before sunset, at which point cups were emptied out on rose leaves. The total level of *C. carnea* was calculated using the afore-mentioned formula used for *E. plumerii*. *C. carnea* was released once per season starting on July 15, 2006 and 2007.

Sampling mites and piercing and sucking insects

The population densities of *T. urticae* and the previous piercing and sucking insect eggs and live stages as well were recorded and monitored bi-weekly during the 2006-2008 period. A randomized complete block design (RCBD) with 10 replicates was used per treatment. At each sampling date, 30 leaves were randomly selected from each treatment. Prey and predator counts were done using a stereomicroscope.

Statistical analysis

Data obtained were analyzed by a *t*-test with a computer programme (SAS/STAT User's Guide, Ver. 6.03) (SAS Institute 1988) which runs under Windows to determine significant differences between means.

The reduction in percentages of all stages of *T. urticae* and piercing and sucking insect pests' motile stages were estimated by an equation recommended by Henderson and Tilton (1955):

Reduction % = 1 - [(Cb×Ta) / (Ca×Tb)]×100

where Cb = control before application, Ca = control after application, Tb = treatment before application, Ta = treatment after application.

RESULTS

Rose plants were infested gradually with some different pests such as *T. urticae*, *F. occidentalis*, *M. rosae*, and *B. tabaci* during the growing season. The experiment evaluated the effectiveness of the phytoseiid mite (*E. plumerii*) and the predacious insect (*C. carnea*) as important biological control agents to control these pests on rose bushes throughout two growing seasons, 2006-2007 and 2007-2008.

Different stages of the predatory mite, *E. plumerii* and second instars of *C. carnea* were used to combat the *T. urticae* population, which increased in the control treatment. Average numbers were 1.87, 2.4, and 5.37 *T. urticae* adults/leaf, 5.09, 12.33 and 28.6 *T. urticae* immatures/leaf and 4.28, 14.08 and 50.63 *T. urticae* eggs/leaf for *E. plumerii*, *C. carnea* and control treatments, respectively during the first season (2006-2007). It also averaged 2, 2.88 and 6.59 adults/leaf, 6.36, 14.06 and 33.85 immatures/leaf and 5.77, 17.21 and 49.65 eggs/leaf of the previous pest for *E. plumerii*, *C. carnea* and control treatments, respectively in the second season (2007-2008).

E. plumerii reduced all stages of *T. urticae* with averages 72.74, 88.87 and 97.65% for adults, immatures and eggs, respectively more than by the predatory insect, *C. carnea*, which averaged 59.97, 62.12 and 77.65% for the three mite stages, respectively through the 2006-2007 period. Percentages were also successfully reduced during the second season (2007-2008) whereas the predatory mite controlled *T. urticae*, by 71.41, 88.93 and 96.8%, respectively for adults, immatures and eggs compared to the predatory insect, which averaged 59.48, 62.65 and 76.34% for the three mite stages, respectively (**Table 1**).

The predatory insect, *C. carnea* had significant action against the populations of the insect pests as the total average numbers of *M. rosae*, *F. occidentals* and *B. tabaci* were 0.51, 0.89 and 1.46 individuals/leaf, respectively. The predatory mite, *E. plumerii* had a low potential of reducing these populations, 3.38, 2.81 and 3.01 individuals/leaf, respectively; the control treatment accounted 4.52, 4.97 and 4.93 individuals/leaf, respectively through the season (2006-2007). These populations during the second season averaged 0.66, 0.94 and 1.46 individuals/leaf, respectively for the three insects. Unlike the predatory mite, *E. plumerii* averaged 3.85, 2.58 and 2.89 individuals/leaf, respectively in comparison with the control treatment, 5.01, 4.87 and 4.95 individuals/leaf, respectively.

Accordingly, the reduction in percentage was high for the predatory insect, *C. carnea*, as it strongly affected *M. rosae* numbers with an average of 95.39% followed by 86.31 and 73.95% for both *F. occidentalis* and *B. tabaci* during the 2006-2007 season; it accounted for 94.6, 87.71

Table 1 Average number and reduction percentage of *T. urticae*/leaf infesting rose leaves (*R. hybrida* cv. 'Huddly') in Orman Botanical Garden, Giza Governorate during 2006-2007 and 2007-2008 growing seasons after releasing two biological control practices.

Sampling date		Number of *T. urticae*/leaf								
		Adults			Immatures			Eggs		
		E. plumerii	*C. carnea*	Control	*E. plumerii*	*C. carnea*	Control	*E. plumerii*	*C. carnea*	Control
2006-2007	No.	1.87 b	2.40 b	5.37 a	5.09 c	12.33 b	28.60 a	4.28 c	14.08 b	50.63 a
	%	72.74	59.97	--	88.87	62.12	--	97.65	77.65	--
2007-2008	No.	2.00 c	2.88 b	6.59 a	6.36 c	14.06 b	33.85 a	5.77 c	17.21 b	49.65 a
	%	71.41	59.48	--	88.93	62.65	--	96.80	76.34	--

No.: average number, %: average reduction percentage. Different letters across both years and for all developmental stages indicate significant differences.

Table 2 Average number and reduction percentage of sucking insect pests/leaf infesting rose leaves (*R. hybrida* cv. 'Huddly') in Orman Botanical Garden, Giza Governorate during 2006-2007 and 2007-2008 growing seasons after releasing two biological control practices.

Sampling date		Number of insect pests/leaf								
		M. rosae			*F. occidentalis*			*B. tabaci*		
		E. plumerii	*C. carnea*	Control	*E. plumerii*	*C. carnea*	Control	*E. plumerii*	*C. carnea*	Control
2006-2007	No.	3.38 b	0.51 c	4.52 a	2.81 b	0.89 c	4.97 a	3.01 b	1.46 c	4.93 a
	%	21.82	95.39	--	48.87	86.31	--	38.83	73.95	--
2007-2008	No.	3.85 b	0.66 c	5.01 a	2.58 b	0.94 c	4.87 a	2.89 b	1.46 c	4.95 a
	%	21.07	94.60	--	49.58	87.71	--	37.04	72.12	--

No.: average number, %: average reduction percentage. Different letters across both years and for all developmental stages indicate significant differences.

and 72.12% for *M. rosae*, *F. occidentalis* and *B. tabaci*, respectively during the 2007-2008 season.

On the other hand, a lower percentage reduction was observed by *E. plumerii*, reducing *M. rosae*, *F. occidentalis* and *B. tabaci* by on average 21.82, 48.87 and 38.83%, respectively during the first season (2006-2007) and by 21.07, 49.58 and 37.04% for the second season (2007-2008) (**Table 2**).

DISCUSSION

Rose plants are infested with some pests such as *T. urticae*, *F. occidentalis*, *M. rosae* and *B. tabaci* during the growing season. Shereef *et al*. (1981) stated that rose plants were mainly infested with *Oligonychus mangiferus* (Rahman & Sapra) and *T. arabicus* Attiah.

Metwally *et al*. (2008) reported that the predator mite, *E. scutalis* (Athias-Henriot) could play a great role in controlling the two-spotted spider mite, *T. urticae* on apple seedlings, so that it can be successfully used as a bio-control agent in controlling this mite pest on different vegetable and orchard trees. Regarding the release of the two predators, *E. plumerii* and *C. carnea*, on rose bushes to control some sucking pests, results are in agreement with those of Reddy (2001) who pointed similar results of the control of red spider mite, *T. ludeni* Zacher on eggplant (*Solanum melongena* L.) using the predator *C. carnea* in integrated pest management. Also it agrees with the results of Blümel and Walzer (2002) who used separate and combined release of *P. persimilis* and *Neoseiulis californicus* (McGregor) for controlling *T. urticae* on greenhouse cut roses under integrated pest management conditions. It also coincided with the findings of Heikal *et al*. (2004), who used the predatory mite, *P. macropilis* (Banks) to reduce the population of *T. urticae* on rose bushes at Orman Botanical Garden, with a mean reduction of 85%.

However, El-Saiedy (2003) reported that the percentage reduction ranged from 34 to 89.78% and from 43 to 78.49% for *E. scutalis* Athias-Henriot and *Amblyseius barkeri* Hughes, respectively, when they used for controlling *T. urticae* on strawberry.

The texture of a plant's leaves may play an important role in reducing the percentage of predatory mites, whereas the leaves of roses harboring fewer hairs which get the predatory mite a high researching capacity for easily movements, to reduce the population of *T. urticae* highly. In contrast, the strawberry leaves have more hairs which sometimes restrict the movements of the predatory mites.

The predatory insect, *C. carnea* greatly reduced the number of pests, *M. rosae*, *F. occidentals* and *B. tabaci*. Predation of *C. carnea* on aphids, whitefly, thrips, American bollworms, pear psyllids, mites, yellow-striped army worms and mealy bugs has been widely reported (Jin 1986; Sengonça *et al*. 1987; Butler and Henneberry 1988). Some of these sucking insect pests were reduced by using many predators (Wardlow *et al*. 1991; Agostinelli *et al*. 1992; Luk'yanova and Veremeev 1993; Trjapitzin and Lewis 1995; Wilhelm 1997; Pasini *et al*. 1999; Courcy–Williams 2001; Klatt and Nennmann 2002; Zhang *et al*. 2004).

A lower percentage reduction was observed by *E. plumerii*, which reduced these pests, i.e., *M. rosae*, *F. occidentalis* and *B. tabaci*. These results suggest that the nutritional quality of each prey affects the percentage reduction caused by the predatory mite, preferring to attack tetranychid mites rather than any other sucking insects. These results agree well with those of Mahgoub (2006), who reported that *P. macropilis* and *N. californicus* poorly reduce three plant-sucking insects, *Thrips tabaci* Lindeman, *Aphis gossypii* Glover and *B. tabaci* infesting two cucumber cultivars during two successive seasons (2004 and 2005).

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