Acta Phytopathologica et Entomologica Hungarica 34 (4), pp. 355–361 (1999)

Effect of Rosemary and Sweet Marjoram on three Predacious Mites of the Family Phytoseiidae (Acari: Phytoseiidae)

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The direct toxicity of two essential oils, *Majorana hortensis,* Moench and *Rosmarinus officinalis* L. to adult females of the predacious mites, *Amblyseius zaheri* Yousef and El-Borolossy, *Amblyseius barkeri* (Hughes) and *Typhlodromus athiasae* Porath and Swirski were tested. Rosemary oil was the most toxic to females of *A. barkeri* and the least to *A. zaheri.* In contrast, sweet marjoram oil was relatively toxic to *T. athiasae* and slightly toxic to *A. barkeri.* Both essential oils, decreased the food consumption rate at the concentration used for *A. barkeri* and *A. zaheri.* Females of *A. barkeri* and *A. zaheri* suffered a depression in reproduction when treated with 1% of rosemary oil. Both material used seems to be harmless to *T. athiasae* at 1%.

Key words: Acari: *Amblyseius barkeri, Amblyseius zaheri,* essential oils, *Typhlodromus athiasae.*

The predacious mites, *Amblyseius barkeri* (Hughes), *Amblyseius zaheri* Yousef and El-Borolossy and *Typhlodromus athiasae* Porath and Swirski, have played an important role in biological control of the spider mites, *Tetranychus urticae* Koch and *Eutetranychus orientalis* (Klein) in Egypt (Momen, 1995, Abou-Elella, 1998, Momen and El-Borolossy, 1999, Zaher et al., 1999). There was a critical need to test pesticides for their side effects on beneficial organisms which are present along with the target pest (Theiling and Croft, 1988). The use of chemical pesticides offers problems such as atmospheric pollution and residual toxicity in food, therefore research on the anti-feedants, which often derived from plants is needed. Among these botanicals, *Majorana hortensis* Moench and *Rosemarinus officinalis* L. which are considered as two of the most valuable aromatic and medicinal plants. The first report from Egypt by (Amer et al., in prep.) demonstrated that, both above materials are potent mite repellent and antifeedant for *E. orientalis* and *T. urticae.* The effect of *M. hortensis* and *R. officinalis* on the predacious mites has not been studied before. However a few studies on Neem extracts and other types of plant extracts have been conducted on phytoseiid mites such as *Euseius scutalis* Athias-Henriot (=*Amblyseius gossipi* El-Badry), *T. athiasae, A. barkeri, Amblyseius swirskii* (A. H.), *A. zaheri* and *Typhlodromus exhilaratus* Ragusa (Dimetry and Amer, 1992; Mansour et al., 1993; Dimetry et al., 1994; Momen and Amer, 1994; Momen et al., 1997; Tsolakis et al., 1997).

This is the second report from Egypt on essential oils, was undertaken to provide information on the direct effect of *M. hortensis* and *R. officinalis* on the predacious mites, *A. barkeri, A. zaheri* and *T. athiasae* in the laboratory.

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Materials and Methods

Maintenance of mite stock cultures

The stock cultures of *T. urticae* were collected from infested lima bean (*Phaseolus vulgaris* L.) in the laboratory at N. R. C. Cairo. The predacious mites *A. zaheri* and *A. barkeri* were found on leaves of eggplant and cucumber and were fed *T. urticae* in the laboratory. *T. athiasae* was collected from an apple orchard and reared on eggs and immature stages of *T. urticae.* The mites were kept in a controlled climate room at 25–27 ºC and 60 ± 5% R. H.

Preparation of the material tested

Both oils, *R. officinalis* and *M. hortensis* were extracted by submitting the air dried herb of each steam distillation for 3 hours in Clevenger apparatus. The oil was collected from each kind was dehydrated over anhydrous sodium sulphate.

Treatment
Effect of R. officinalis *and* M. hortensis *oils on adult females of some predacious mites*

Each adult females of 3 predators species (*A. zaheri, A. barkeri* and *T. athiasae*) were confined separately on the lower surfaces of detached raspberry leaves (3 cm in dia.) while the upper surfaces were placed on cotton saturated with water. Predacious mites were sprayed using a glass atomizer. Each test contained 5 concentrations and each concentration had 4 replicates (20 females/replicate). In every test, a water control was included. Mortality was recorded 48 h after application. Corrected mortality counts according to Abbott's formula (1925), were statistically analysed by (Finney, 1952).

Effect of R. officinalis *and* M. hortensis *oils on adult fecundity, sex ratio and consumption of treated predacious mites*

Newly emerged and mated females of 3 predator species were treated with a concentration (1%), which has been proved to be effective against *T. urticae* (Amer et al., in prep.). Females transferred singly to the lower surface of raspberry leaf discs and were provided daily with a sufficient known number of *T. urticae* nymph for 1 week. A control treatment was included in each test for different predators. Observation were taken daily on consumption, reproduction, mortality and sex ratio of the progeny for 7 successive days. Statistical analysis were carried out using the "F" test. Calculation of the adverse effect of different extracts on the predators was done according to the formula of (Overmeer and Van Zon, 1982). According to (Hassan, 1985), the adverse effect (E) of the treatment was classified to the following categories:

1. E = 0–25% harmless.
2. E = 26–50% slightly harmful.
3. E = 51–75% moderately harmful.
4. E = 76–100% harmful.

The percentage of reduction in food consumption was calculated according to (Samsoe-Petersen, 1983).

Results and Discussion

Effect of R. officinalis *and* M. hortensis *oils on adult females of some predacious mites*

Figures 1 and 2 show the relation between the percentage of mortality and the concentrations of both rosemary and sweet marjoram oils on adult females of *A. barkeri, A. zaheri* and *T. athiasae.* The data obtained in Fig. 1 shows that rosemary oil was the most toxic to females of *A. barkeri* and the least toxic to females of *A. zaheri.*

Based on the LC_{50} value of rosemary oil, toxicity were in an ascending order as follows (9.91, 5.80 and 4.34%, respectively) for *A. zaheri, T. athiasae* and *A. barkeri.*

Results from Fig. 2 shows that sweet marjoram oil was relatively the most toxic to females of *T. athiasae* and the least toxic to females *A. barkeri.* The results indicated also that both materials tested, had similar toxicity effect on *T. athiasae* (LC_{50}: 5.80 and 5.32% for rosemary and sweet marjoram oils, respectively). Mansour et al. (1993) revealed that RD9 – Repelin was highly toxic to *T. athiasae,* but Margosan-O and Azatin were not toxic.

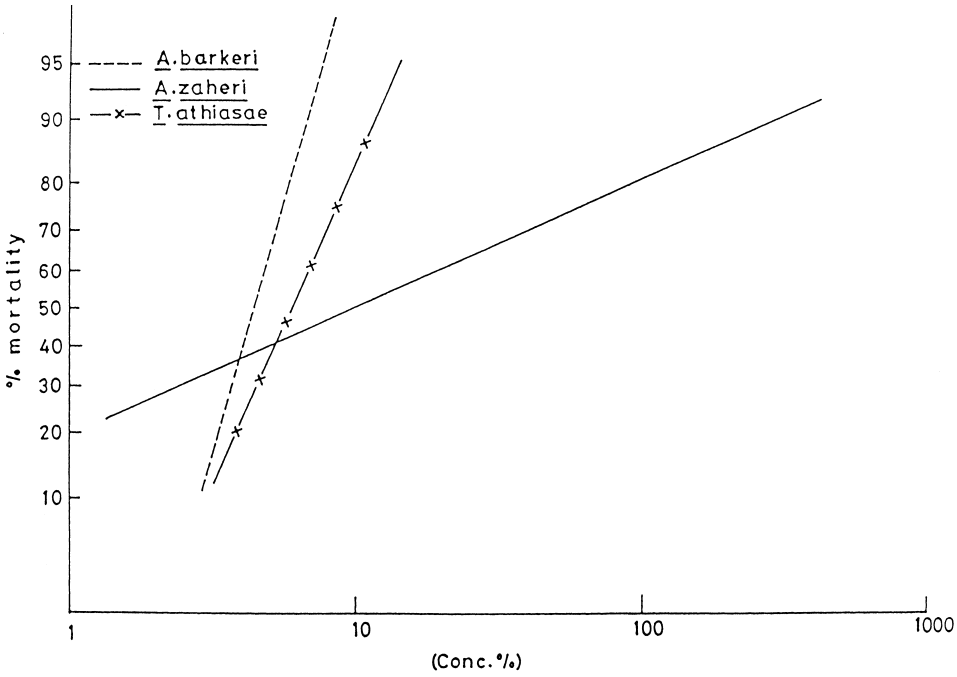

Fig. 1. Toxicity of rosemary oil against adult females of the predacious mites, *A. barkeri, A. zaheri* and *T. athiasae*

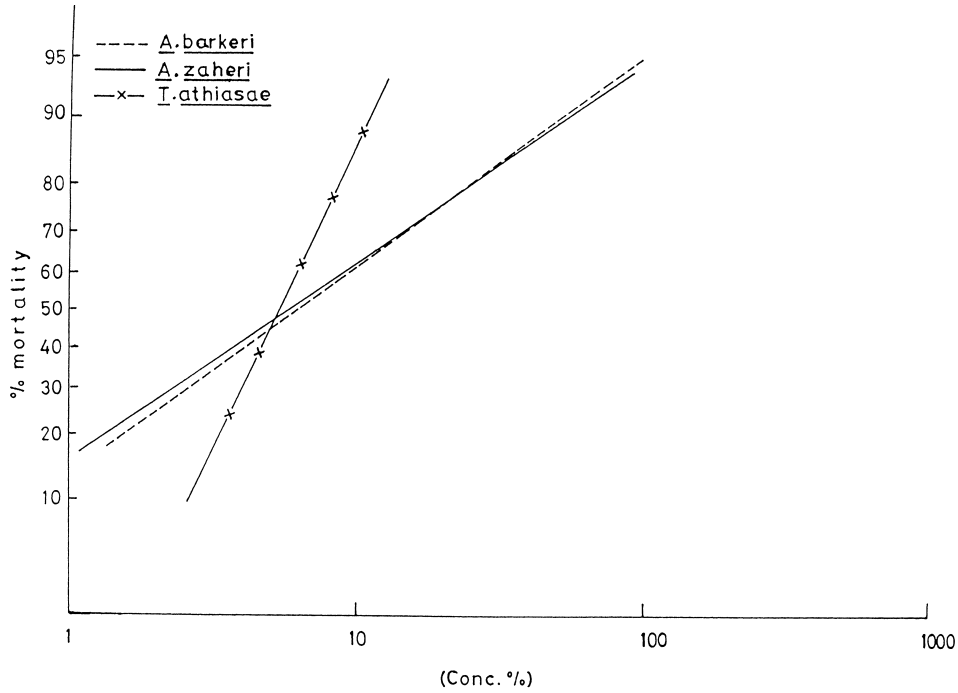

Fig. 2. Toxicity of sweet marjoram oil against adult females of the predacious mites, *A. barkeri, A. zaheri* and *T. athiasae*

In previous studies by (Momen and Amer, 1994), it was shown that lupin extract was slightly toxic to eggs and females of *A. barkeri,* while fenugreak, canna and turnip extracts were not toxic for the predator.

Effect of R. officinalis *and* M. hortensis *oils on adult fecundity, sex ratio and consumption of treated predacious mites*

Results from Table 1 show that a significant lower consumption rate were recorded at conc. 1% on treated adult females of *A. zaheri* and *A. barkeri* with rosemary and sweet marjoram oils. The percentage of reduction in the food consumption decreased to 8.75 and 13.09% for both above oils for *T. athiasae.* Momen et al. (1997) reported a significant lower consumption at conc. 0.2% on treated females of *A. zaheri* and *A. barkeri* when exposed to nymphs of *T. urticae* formerly kept together on plant leaves treated with Neem-Azal-F. Similar result was recorded also on *A. barkeri* when kept on treated leaves with lupin extract, Margosan-O and Neem-Azal-S (Momen and Amer, 1994; Dimetry et al., 1994).

Results from Table 2 show that both rosemary and sweet marjoram oils appeared to be harmless for *T. athiasae* as no significant reduction in fecundity was recorded. In addition, mortalities was 5% after 1 week treatment, with both oils. The adverse effect of both materials was slightly harmful on *A. zaheri* and *A. barkeri* (E < 50%). Both oils used

Table 1

Effect of rosemary and sweet marjoram on the food consumption of *A. zaheri, A. barkeri* and *T. athiasae*

Treatments	Total prey/Female/7days	Total prey/Female/day	% Reduction in food consumption
		A. zaheri	
Rosemary	68.2	9.74	18.81
Sweet marjoram	72.7	10.39	13.45
Control	84.0	12.0	
0.05		0.834	
L.S.D.			
0.01		1.143	
		A. barkeri	
Rosemary	89.6	12.8	32.07
Sweet marjoram	98.4	14.06	25.40
Control	131.9	18.84	–
0.05		1.051	
L.S.D.			
0.01		1.440	
		T. athiasae	
Rosemary	75.65	10.81	8.75
Sweet marjoram	72.05	10.29	13.09
Control	82.9	11.84	–
0.05		1.142	
L.S.D.			
0.01		1.564	

were caused (10–20%) mortalities, respectively, on adult females of *A. barkeri* tested after 1 week treatment.

Results obtained in Table 2 show also a significant reduction in the total number of eggs laid/female during 7 days period for *A. zaheri* and *A. barkeri* in case of rosemary oil at conc. 1%. Previous studies by (Momen et al., 1997) demonstrated that Neem Azal-F appeared to be harmless for *A. barkeri* and *A. zaheri.* Again *A. barkeri* suffered a drop in reproduction when fed on prey kept on treated leaves with lupin, turnip and fenugreek extracts (Momen and Amer, 1994). Studies by various authors revealed that some toxicants had no immediate effect on predacious mites but reproduction might be disturbed (van de Vrie, 1962; Daneshvar, 1963; El-Banhawy, 1976). Neither egg hatchability nor the sex-ratio of the progeny were affected by both oils tested on phytoseiids. The sex ratio was tended in favour of females.

Table 2

Effect of rosemary and sweet marjoram on the reproduction, mortality and sex-ratio of the progeny of treated females of *A. zaheri, A. barkeri* and *T. athiasae*

Treatments	Total No. Eggs/ Female/7 days	No eggs/ Female/day	% M. after 7 days	% Adverse effect	Sex-ratio male : female
			A. zaheri		
Rosemary	9.65	1.38	5	30.55	1 : 2.6
Sweet marjoram	10.05	1.44	5	27.67	1 : 2.3
Control	13.2	1.89	0	–	1 : 2.4
0.05		0.351			
L.S.D.					
0.01		0.481			
			A. barkeri		
Rosemary	14.45	2.06	10	31.55	1 : 2.2
Sweet marjoram	17.15	2.45	20	27.79	1 : 3.1
Control	19.0	2.71	0	–	1 : 3.0
0.05		0.440			
L.S.D.					
0.01		0.602			
			T. athiasae		
Rosemary	13.2	1.89	5	24	1 : 1.8
Sweet marjoram	14.65	2.09	5	15.65	1 : 2.1
Control	16.5	2.36	0	–	1 : 2.1
0.05		0.518			
L.S.D.					
0.01		0.618			

Conclusions

Our results indicated that both oils used which were toxic to the pest *T. urticae* are satisfactory for the predator *T. athiasae.* The use of a botanical pesticide that is relatively nontoxic to natural enemies could increase the effectiveness of natural predation. *T. athiasae* is a key predator of spider mites in deciduous orchards, vineyards and vegetable field (Swirski et al., 1967). Therefore the work presented here is based on laboratory data, which are not always directly transferable to the field. Therefore, is should be mentioned that the use of anti-feedants as practical pest control agents requires considerable experimentation and developments. UV-light, rain fall, temperature, and perhaps PH value on treated leaves are important environmental factors when both oils are applied for pest control in the field.

Field trials are therefore necessary in order to determine the effect of both oils *R. officinalis* and *M. hortensis* will have on *T. athiasae, A. barkeri* and *A. zaheri* and other phythoseiid populations in crop fields and apple orchards.

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