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Influence of the Sweet Basil, *Ocimum basilicum* L. on Some Predacious Mites of the Family Phytoseiidae (Acari: Phytoseiidae)

F. M. MOMEN and S. A. A. AMER

National Research Centre, Pests and Plant Protection Department,
Dokki, Cairo, Egypt

The direct toxicity of the essential oil, *Ocimum basilicum* L. to females of six species of predacious mites of the family phytoseiidae was tested. The phytoseiid mites tested namely, *Typhlodromus athiasae* Porath and Swirski, *Euseius yousefi* Zaher and El-Borolossy, *Amblyseius zaheri* Yousef and El-Borolossy, *Amblyseius deleoni* (Muma and Denmark), *Amblyseius swirskii* Athias-Henriot and *Amblyseius barkeri* (Hughes). Sweet basil oil was highly toxic to females *E. yousefi* and was relatively intoxic to females *A. swirskii.* The essential oil has a close toxic effect for predator species, *T. athiasae* and *A. barkeri.* With the exception of *A. zaheri,* females of all predacious mites tested suffered a depression in reproduction and food consumption when treated with sweet basil oil at conc. 2%.

Keywords: *Ocimum basilicum,* predacious mites, *Phytoseiidae.*

The members of the family Phytoseiidae are known as the major natural enemies in suppressing the population of spider mites as well as pest insects (Huffaker et al., 1970; McMurtry, 1982; Hoy and Glenister, 1991). The predacious mites *Amblyseius zaheri* Yousef and El-Borolossy, *Amblyseius deleoni* (Muma and Denmark) and *Amblyseius swirskii* Athias-Henriot are 3 of the most important biocontrol agents of spider and eriophyid mites on various crops and orchards in Egypt (Metwally et al., 1984; Momen and El-Sawy, 1993; Abou-Elella, 1998). *Amblyseius barkeri* (Hughes) has played an important role in biological control of the onion thrips, *Thrips tabaci* Lindeman in glasshouses with cucumber in Denmark (Hansen, 1988) and in United states on cabbage (Hoy and Glenister, 1991). *A. barkeri* has also been shown to be an effective predator on tetranychid and eriophyid mites in Egypt (Momen, 1995). Another 2 phytoseiid mites which may of importance in biological control programmes are *Typhlodromus athiasae* Porath and Swirski and *Euseius yousefi* Zaher and El-Borolossy (Swirski et al., 1967; Momen, 1999; Momen and El-Borolossy, 1999; Zaher et al., 1999; Momen, 2001).

The effect of the essential oils and their isolates on the predacious mites is not studied extensively yet, although few studies were conducted on phytoseiid mites and some oils of *Majorana hortensis* Moench and *Rosmarinus officinalis* L. *Mentha piperita* L. and *Mentha virdis* L. (Momen and Amer, 1999; Momen et al., 2001). Essential oils that possess antagonistic activity against mite pests have received special attention the last few years (Mansour et al., 1986; Amer et al., 1993; Perrucci 1995; Amer et al., 2001; Momen et al., 2001; Refaat et al., 2002). Because of the predacious mites of the family phyto-

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seiidae are associated with phytophagouse mites in orchard and fields, research has to be done to investigate the acaricidal activity of essential oils against the predacious mites, which play an important role in biological control. This report is a part from an intensive studies on the effect of essential oils on the predacious mites of the family phytoseiidae in Egypt. This study was undertaken to provide information on the direct effect of *Ocimum basilicum* L. on six predacious mites of the family phytoseiidae, as well as its effect on some biological aspects in the laboratory.

Materials and Methods

Three steps were followed during the experiments on effects of *O. basilicum* on different phytoseiid mites.

1. Laboratory stock cultures

The stock cultures of *Tetranychus urticae* Koch 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. *A. swirskii* and *T. athiasae* were collected from an apple orchard and reared on eggs and immature stages of *T. urticae. E. yousefi* was found on leaves of *Zizyptus spina christ* L. and reared on pollen from date palm *Phoenix dactylifera* L.; *A. deleoni* was collected from debris under mango *Mangifera indica* L. and pear *Pyrus communis* L. trees and were fed *T. urticae.* The mites were kept in a controlled climate room at 25–27 ºC and 60 ± 5% R. H.

2. Preparation of the material tested

Oil of sweet basil *O. basilicum* was obtained from the air dried plant material (aerial parts), was pulverized and the essential oil was isolated after hydrodistillation for 3 hours using Clevenger apparatus and dehydrated over anhydrous sodium sulfate. Emulsion of oil was prepared by mixing of Triton-X 100. Different concentrations were prepared and tested against females of different predacious mites.

3. Treatment

3.1. DIRECT EFFECT ON ADULT FEMALES OF DIFFERENT PREDACIOUS MITES

Each adult females of 6 predator species 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. Tangle foot was applied on the edge of the discs to prevent the predator from escaping. Mites were sprayed using a glass atomizer. Each test contained 5 concentrations and each concentration had 4 replicates (20 females/replicate) and each assay was repeated twice. In every test, a water control was included. Mortality was recorded 48 h after application. Corrected mortality counted according to Abbott's formula (1925), and was statistically analysed by Finney (1952).

3.2. INDIRECT EFFECT ON ADULT FEMALES OF DIFFERENT PREDACIOUS MITES

The effect of sweet basil oil on the reproduction, sex ratio consumption and mortality of treated predacious mites was also studied. Newly emerged and mated females of 6 predator species were sprayed with a concentration 2% which has been proved to be effective against *T. urticae* (Refaat et al., 2002). Females transferred singly to the lower surface of raspberry leaf discs and were provided daily with a sufficient known number of *T. urticae* nymphs for 7 days. Twenty replicates were used per treatment for each predator species. A control treatment was included in each test for different predacious mites. Observations were taken daily on consumption, reproduction, hatchability, sex ratio of the progeny, and mortality for 7 successive days.

Statistical analysis was carried out using the *t*-test. The percentage of reduction in food consumption was calculated according to Samsoe-Petersen (1983), while the adverse effect of sweet basil oil on the predators was done according to the formula of Overmeer and van Zon (1982). The classification of the adverse effect by Hassan (1985) was followed in the present study.

Results and Discussion

Direct effect of sweet basil on adult females of different predacious mites

The data obtained in *Table 1* shows that adult females of *E. yousefi* was more sensitive (LC_{50} = 2.93%) to sweet basil oil, while females of *A. swirskii* was less susceptible (LC_{50} = 12.00%), respectively. Comparison of the LC_{50} values of this study to the LC_{50} values of other essential oils and the above species are acceptable because all experiments were conducted at similar conditions. Similar toxic effect of *Mentha viridis* (LC_{50} = 2.95%) and *Mentha piperta* (LC_{50} = 2.31%) on *E. yousefi* was reported by Momen et al. (2001). Research carried out by Amer and Momen (2002) revealed that the essential oil of *Lavandula officinalis* Chaix relatively intoxic to *A. swirskii* (LC_{50} = 24.14%), in contrast, *M. piperta* (LC_{50} = 2.41%) and *M. hortensis* (LC_{50} = 3.07%) were toxic to the predator. Results in the present study indicated also that oil of *O. basilicum* has a close toxic effect

Table 1

Toxicity of sweet basil oil to females of 6 predacious mites of the family Phytoseiidae

Species	% LC_{50}	% LC_{90}	Slope	Relative toxicity at:	
				LC_{50}	LC_{90}
E. yousefi	2.93	5.72	4.40	100	100
T. athiasae	4.09	13.38	2.49	71.64	42.75
A. barkeri	4.18	9.28	3.69	70.10	61.64
A. zaheri	5.27	7.08	9.93	55.60	80.79
A. deleoni	6.00	8.35	8.90	48.83	68.50
A. swirskii	12.00	93.85	1.43	24.42	6.09

for *T. athiasae* and *A. barkeri* (LC_{50} = 4.09% and 4.18%), respectively. Based on the LC_{50} value of the above tested mites, and LC_{50} of other essential oils studied by Momen and Amer (1999) and Momen et al. (2001), toxicity were in descending order in *A. barkeri* as follows: *M. piperta, O. basilicum, R. officinalis, M. hortensis* and *M. virdis.* In case of *T. athiasae,* the toxicity was in descending order was *M. piperta, O. basilicum, M. hortensis, R. officinalis* and *M. virdis.* Sweet basil oil has close toxic effect on *A. deleoni* (LC_{50} = 6.0%) and *A. zaheri* (5.27%) in the present study. Based on the LC_{50} value of the tested mites, toxicity were in ascending order of effectiveness as follows: *A. swirskii, A. deleoni, A. zaheri, A. barkeri, T. athiasae* and *E. yousefi.*

Indirect effect on adult females of different predacious mites

Results from *Table 2* show that a significant lower consumption rate were recorded at conc. 2% on treated females of different predacious mites except for *A. zaheri.* Similar lower consumption rate were recorded at conc. 1% on treated adult females of *A. zaheri* and *A. barkeri* with rosemary and sweet marjoram oils (Momen and Amer, 1999). The percentage reduction in the food consumption decreased to 95.99% in case of *A. barkeri* and to 29.90% on *T. athiasae,* while the percentage reduction was not significant in case of *A. zaheri* (2.45%).

Table 2

Effect of sweet basil oil on the food consumption of 6 predacious mites of the family phytoseiidae

Species	Conc.	Consumption (female) 7 days	Consumption (female) day ± S. E.	% Reduction in food consumption
A. barkeri	2%	4.95	0.71 ± 0.10	95.99
	Control	123.95	17.71 ± 0.16	
A. deleoni	2%	14.45	2.06 ± 0.09	82.30
	Control	81.45	11.64 ± 0.11	
A. swirskii	2%	34.20	4.89 ± 0.67	66.44
	Control	102.00	14.57 ± 0.34	
E. yousefi	2%	40.10	5.73 ± 0.39	53.83
	Control	86.90	12.41 ± 0.95	
T. athiasae	2%	86.15	12.31 ± 0.28	29.90
	Control	122.95	17.56 ± 0.61	
A. zaheri	2%	89.15	12.74 ± 0.18	2.45
	Control	91.45	13.06 ± 0.29	

t at 0.05 = 2.447; t at 0.01 = 3.707

Results from *Table 3* show that, sweet basil at 2% conc. caused 45% and 30% mortalities to the predators *E. yousefi* and *A. barkeri,* while no mortality was recorded in case of *A. zaheri* after 1 week treatment with the exception of *A. zaheri* a significant reduction in the total number of eggs laid/female during 1-week period for treated all predator

Table 3

Effect of sweet basil oil on the reproduction, mortality and sex ratio of treated females of different predacious mites

Species	Conc.	No. eggs (female) 7 days	No. eggs (female) day ± S. E.	% Mortality after 7 days	Adverse effect	Sex-ratio male : female
A. barkeri	2%	0.45	0.06 ± 0.04	30	97.98	1 : 0.75
	Control	14.55	2.08 ± 0.08	0		1 : 3.36
A. deleoni	2%	0.70	0.10 ± 0.03	10	95.36	1 : 1.25
	Control	13.55	1.94 ± 0.19	0		1 : 2.55
A. swirskii	2%	2.60	0.37 ± 0.13	10	84.22	1 : 1.11
	Control	14.80	2.11 ± 0.10	0		1 : 2.10
E. yousefi	2%	5.35	0.76 ± 0.14	45	76.78	1 : 1.30
	Control	12.60	1.8 ± 0.17	0		1 : 2.20
T. athiasae	2%	10.60	1.5 ± 0.04	20	46.55	1 : 1.73
	Control	15.80	2.26 ± 0.11	0		1 : 1.54
A. zaheri	2%	13.80	1.9 ± 0.02	0	7.51	1 : 2.90
	Control	14.90	2.13 ± 0.05	0		1 : 3.18

t at 0.05 = 2.447; t at 0.01 = 3.707

females was recorded (7.51%). The adverse effect of sweet basil oil where harmless to *A. zaheri* and slightly harmful to *T. athiasae* while it was harmful to *A. barkeri, A. deleoni, A. swirskii* and *E. yousefi* at conc. 2%. The sex-ratio of the progeny was in favour of females in case of *A. zaheri* and *T. athiasae.* Previous studies by Momen et al. (1997) demonstrated that Neem Azal-F appeared to be harmless for *A. barkeri* and *A. zaheri* van de Vrie (1962) and Daneshvar (1963) revealed that some toxicants had no immediate effect on predacious mites but reproduction might be disturbed.

Conclusion

On scrutinizing our results it will be shown that oil of *O. basilicum* was satisfactory as regards relatively both high mortality for *T. urticae* and *E. orientalis* (Refaat et al., 2002) and insignificant reduction of fecundity for *A. zaheri. E. yousefi,* two phytoseiids which are an important predators of *T. urticae* (Momen, 1999, 2001), was affected by oil of *O. basilicum.*

Plant of *O. basilicum* typically have an aniseed-like aroma and sweet taste, the essential oil responsible for these features is methyl chavicol (Riaz et al., 1994; Grayer et al., 1996; Refaat et al., 2002), which contributed with more than 80% of oil content. Grayer et al. (1996) stated that a part from using fresh or dried *O. basilicum,* there are other factors which may potentially affect the essential oil percentages determined, such as the extraction method employed, the age and organ of the plant used for study and the

environmental conditions under which the plants have been grown. Predacious mites in the family phytoseiidae are important natural enemies of several phytophagous mite pests on various crops (Laing, 1968; Bonde, 1989). Therefore integrated pest management programmes rely heavily on maximum preservation of predatory insects and mites, particularly phytoseiids. Several species of phytoseiid mites have been released to control insect and mite pests (Bonde, 1989), so in integrated control programmes, a careful choice of essential oil should be made to harm phytoseiid population as little as possible.

The impact of *O. basilicum* on *A. zaheri* in the field, is difficult to predict from these laboratory data. Mortality may be greater or lesser in the field because of factors such as the sensitivity of the oil to U. V. light poor coverage or the effects of long-term exposure. Therefore, a comparison between field and laboratory tests is especially needed to evaluate such delayed effects.

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