

Effect of Some Essential Oils on the Predacious Mite *Amblyseius swirskii* A. H. (Acari: Phytoseiidae)

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

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

The direct toxicity of four essential oils, *Majorana hortensis* Moench, *Rosmarinus officinalis* L., *Mentha piperita* L. and *Lavandula officinalis* Chaix, to adult females of the predacious mite *Amblyseius swirskii* Athias-Henriot were tested. Peppermint oil was the most toxic to females *A. swirskii* while the French lavender oil was the least toxic to the predator. All essential oils, at the two concentrations used, decreased the food consumption rate as well as egg laying. All four materials tested, at concentration 0.25% were considered to be safe for the predator since no mortalities had been recorded.

Keywords: Acari, *Amblyseius swirskii*, essential oils, Phytoseiidae.

The predacious mite *Amblyseius swirskii* Athias-Henriot is an generalist predator that aids in control of the two spotted spider mite *Tetranychus urticae* Koch, the citrus brown mite *Eutetranychus orientalis* (Klein) and the gall mite *Eriophyes discoridis* Soliman and Abou-Awad (Metwally et al., 1984; Momen and El-Sawy, 1993). In addition to pest mites, the predator can also feed on pollen grains as well as on coccids and mealybugs (Swirski et al., 1967a; Ragusa and Swirski, 1975, 1977). Abou-Awad et al. (1992) reported that the predator *A. swirskii* developed, survived and reproduced successfully on several artificial diets. The effect of the essential oils on the predacious mites is not studied extensively yet.

Momen and Amer (1999) studied the effect of *Majorana hortensis* Moench and *Rosmarinus officinalis* L. on three predacious mites of the family phytoseiidae, namely *Amblyseius barkeri* (Hughes), *Amblyseius zaheri* Yousef and El-Borolossy and *Typhlodromus athiasae*, Porath and Swirski. Research has been done by Momen et al., (2001) revealed that *Mentha piperita* L. proved to be more toxic to the predacious mites, *T. athiasae*, *Phytoseius finitimus* Ribaga, *A. barkeri*, *Amblyseius yousefi* Zaher and El-Borolossy and *Amblyseius deleoni* (Muma and Denmark) than *Mentha viridis* L.

Neem Azal-F a commercial preparation of neem seed kernel extract was highly toxic to *A. swirskii* at concentration 0.2 and 0.05%, respectively (Momen et al., 1997). This report is a part from an intensive studies on the effect of essential oils on the predacious mites of the family Phtoseiidae. The present work was carried out to provide information on the direct effect of *M. hortensis*; *R. officinalis*, *M. piperita* and *Lavandula officinalis* chaix on the predacious mite *A. swirskii*, as well as their effect on some biological aspects in laboratory.

Materials and Methods

Maintenance of mite stock cultures

Adult female of the predacious mite *A. swirskii* were collected from heavily infested apple and mango leaves, and transferred to the rearing substrates. *A. swirskii* were fed eggs and immature stages of *T. urticae*. The stock culture of *T. urticae* were collected from infested lima bean (*Phaseolus vulgaris* L.) in the laboratory at N. R. C., Cairo. The mites were reared in a controlled climate room at 25–27 °C and 60±5% R. H.

Preparation of the material tested

Oils of *R. officinalis*, *M. hortensis*, *M. piperita* and *L. officinalis* were obtained from the air dried plant material (aerial parts) were pulverized and the essential oils isolated after hydrodistillation for 3 hours using cleveger apparatus. The distilled oil of each plant was dehydrated over anhydrous sodium sulphate. Emulsions of different oils were prepared by mixing of Triton – X 100. Different concentrations of the product were prepared and tested against the adult females of *A. swirskii*.

Treatment

The direct effect of some essential oils on adult females of *A. swirskii*. Adult females of *A. swirskii* were confined on the lower surfaces of detached raspberry leaves (4 cm in dia.) while the upper surfaces were placed on cotton saturated with water. Females of *A. swirskii* were sprayed with different concentrations from each oil 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 analyzed by (Finney, 1952).

EFFECT OF SOME ESSENTIAL OILS ON ADULT FECUNDITY, SEX RATIO, CONSUMPTION AND MORTALITY OF TREATED PREDACIOUS, MITE *A. SWIRSKII*

Newly emerged and mated females of *A. swirskii* were sprayed with two concentrations (0.25 and 2.0%) from each oil which has been proved to be effective against *T. urticae* Amer et al. (2000), Momen et al. (2000) and Refaat 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 7 days. Twenty replicates were used per treatment. A control treatment was included in each test for different oils. Observation were taken daily on consumption, reproduction, hatchability, sex-ratio of the progeny and mortality for 7 successive days. Statistical analysis were carried out using the "F" test. The percentage of reduction in food consumption was calculated according to (Samsøe – Petersen, 1983).

Results and Discussion

The direct effect of some essential oils on adult females of A. swirskii

The data obtained in *Fig. 1* shows the relation between the percentage of mortality and the concentrations of the different oils on adult females of *A. swirskii*. The results indicated that peppermint oil was the most toxic oil to adult females ($LC_{50} = 2.91\%$), while French lavender oil was the least toxic one to the predator ($LC_{50} = 24.14\%$), respectively. Tested essential oils can be arranged according to their LC_{50} values for adult females in the following ascending order of effectiveness: French lavender, Rosemary, Sweet marjoram and peppermint. *Figure 1* shows also that the toxic effect of both oils peppermint and Sweet marjoram are close to each other on females of *A. swirskii* ($LC_{50} = 2.91$ and 3.07% ; $LC_{90} = 13.71$ and 13.37%) for peppermint and sweet marjoram oils, respectively. Similarly, peppermint oil was proved to be toxic to the predacious mites, *T. athiasae*, *A. barkeri*, *A. yousefi*, *P. finitimus* and *A. deleoni* (Momen et al., 2000), while sweet marjoram was relatively toxic to *T. athiasae* and slightly toxic to *A. barkeri* (Momen and Amer, 1999). Research has been done by the letter author revealed that rosemary oil was toxic to females of *A. barkeri* and was slightly toxic to *A. zaheri*.

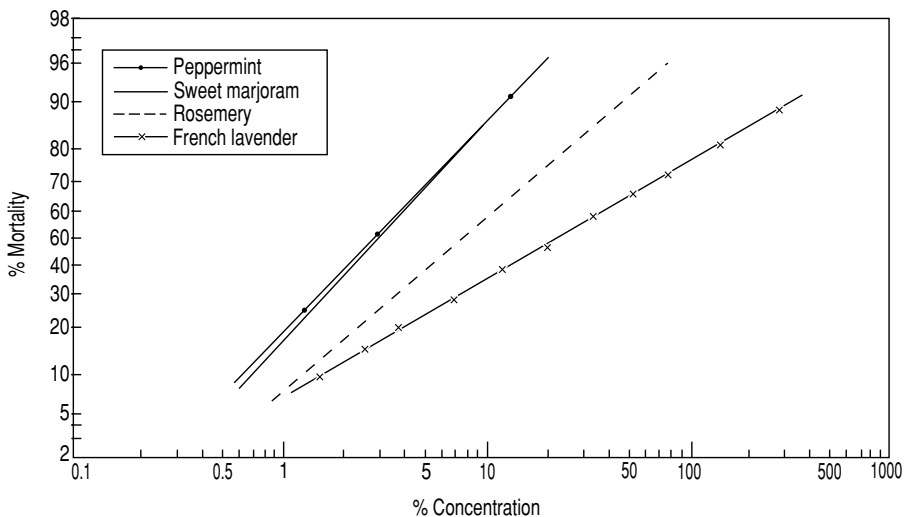


Fig. 1. Relative susceptibility of adult females of *A. swirskii* to some essential oils

Effect of some essential oils on biological aspects of A. swirskii

ON FOOD CONSUMPTION

Results from *Table 1* and *Fig. 2* show that a significant lower consumption rate were recorded at 2% conc. on treated females of *A. swirskii* with rosemary, sweet marjoram, peppermint and French lavender oils. At lower concentration (0.25%) the percentage

Table 1
Effect of some essential oils on food consumption of *A. swirskii*

| Treatments | Concentrations | | | |
|-----------------|-----------------------|---------------------------------|-----------------------|---------------------------------|
| | 2% | | 0.25% | |
| | Total prey/female/day | % Reduction in food consumption | Total prey/female/day | % Reduction in food consumption |
| Rosemary | 3.43** | 76.79 | 4.3** | 70.89 |
| Sweet marjoram | 3.67** | 75.15 | 8.17** | 44.68 |
| Peppermint | 4.01** | 72.82 | 8.71** | 41.01 |
| French lavender | 4.41** | 70.12 | 7.52** | 49.08 |
| Control | 14.77 | | 14.77 | |
| L.S.D 0.05 | 0.966 | | 2.278 | |
| 0.01 | 1.301 | | 3.068 | |

**High significant

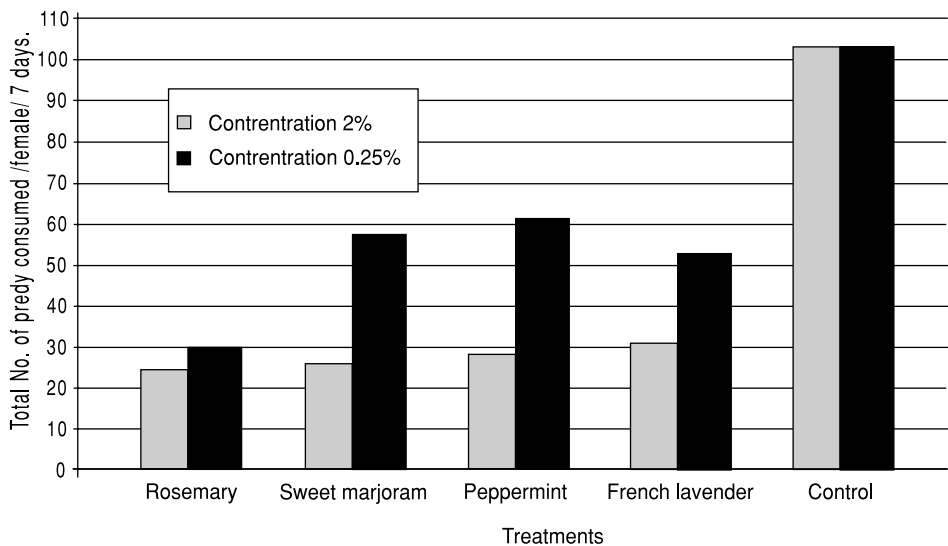


Fig. 2. The food consumed/female *Amblyseius swirskii* during 7 days

reduction in the food consumption decreased to 70.89, 44.68, 41.01 and 49.08 (Table 1). Similar result has been reported by (Momen et al., 1997) on *A. swirskii* since a significant lower consumption rate was recorded on treated females with Neem Azal-F when exposed to nymphs of *T. urticae* formely kept together on plant leaves treated with Neem Azal-F. It was be mention that rosemary and sweet marjoram oils have similar effect on *A. barkeri* and *A. zaheri*.

ON MORTALITY AND EGGS PRODUCTION

Results from *Table 2* show that at both high and low conc. (2, 0.25%) for all oils, a significant reduction in the total average number of eggs laid/female /day during 1 week period for the predator. Previous studies by (Momen and Amer, 1999) revealed that rosemary and sweet marjoram oils appeared to be harmless for *T. athiasae* as no significant reduction in fecundity was recorded at 1% conc. and mortality was 5%. In our studied, peppermint oil at (2% conc.) caused 30% mortality to the predator, while in sweet marjoram oil suffered 5% mortality for the predator after 1 week treatment. The adverse effect of oils were highly affected at (2% conc.) and decreased at (0.25% conc.).

Table 2

Effect of some essential oils on reproduction, mortality and sex-ratio of the progeny of treated females of *A. swirskii*

| Treatments | Total No. of eggs/female/7 days | Total No. of eggs/female/7 day | % M. female after 7 days | % Adverse effect | % Hatching of eggs | Sex-ratio Male : female |
|-----------------|---------------------------------|--------------------------------|--------------------------|------------------|--------------------|-------------------------|
| Rosemary | 3.05 | 0.44** | 0 | 79.53 | 97.5 | 1 : 1.17 |
| Sweet marjoram | 1.9 | 0.27** | 5 | 87.89 | 100 | 1 : 1.08 |
| Peppermint | 3.3 | 0.47** | 30 | 84.50 | 88.24 | 1 : 1.25 |
| French lavender | 4.95 | 0.71** | 0 | 66.78 | 100 | 1 : 1.22 |
| Control | 14.9 | 2.13 | 0 | – | 100 | 1 : 1.98 |
| L.S.D 0.05 | | 0.243 | | | | |
| 0.01 | | 0.327 | | | | |
| | | | 0.25% Conc. | | | |
| Rosemary | 4.35 | 0.62** | 0 | 70.81 | 97.96 | 1 : 1.4 |
| Sweet marjoram | 5.1 | 0.73** | 0 | 65.77 | 100 | 1 : 2.16 |
| Peppermint | 6.15 | 0.88** | 0 | 58.72 | 100 | 1 : 1.32 |
| French lavender | 6.15 | 0.88** | 0 | 58.72 | 100 | 1 : 1.3 |
| Control | 14.9 | 2.13 | 0 | – | 100 | 1 : 1.98 |
| L.S.D 0.05 | | 0.359 | | | | |
| 0.01 | | 0.484 | | | | |

**High significant

ON HATCHABILITY AND SEX-RATIO

With the exception on peppermint oil, egg hatchability was not significantly affected in *A. swirskii* as it averaged between 100–97.5% (*Table 2*). The sex-ratio of the progeny was relatively affected by all tested oils at the higher conc. The sex-ratio was tended in favour of females in the control. Much more field work has to be done to evaluate the effect of different essential oils will have on *A. swirskii* in apple and mango orchards.

Literature

- Abbott, W. S. (1925): A method of computing the effectiveness of an insecticide. *J. Econ. Entomol.* 18, 265–267.
- Abou-Awad, B. A., Reda, A. S. and El-Sawi, S. A. (1992): Effects of artificial and natural diets on the development and reproduction of two phytoseiid mites *Amblyseius gossipi* and *Amblyseius swirskii* (Acari: Phytoseiidae). *Insect – Sci. Applic.* 13, 441–445.
- Amer, S. A. A., Refaat, A. M. and Momen, F. M. (2000): Repellent and oviposition – deterring activity of Rosemary and Sweet marjoram on the spider mites *Tetranychus urticae* and *Eutetranychus orientalis* (Acari: Tetranychidae). *Acta Phytopathologica et Entomologica Hungarica* 36, in press.
- Finney, D. J. (1952): *Probit Analysis a Statistical Treatment of the Sigmoid Response Curve*. Cambridge Univ. Press. Cambridge.
- Metwally, A. M., Abou El-Naga, M. M., Taha, H. A. and Hoda, F. M. (1984): Studies on feeding reproduction and development of *Amblyseius swirskii* A. H. (Acarina: Phytoseiidae). *Agric. Res. Rev.* 62, 323–326.
- Momen, F. M. and Amer, S. A. A. (1999): Effect of Rosemary and Sweet marjoram on three predacious mites of the family Phytoseiidae (Acari: Phytoseiidae). *Acta Phytopathologica et Entomologica Hungarica* 34, 355–361.
- Momen, F. M. and El-Sawy, S. A. (1993): Biology and feeding behaviour of the predatory mite, *Amblyseius swirskii* (Acari: Phytoseiidae). *Acarologia* 34, 199–204.
- Momen, F. M., Amer, S. A. A. and Refaat, A. M. (2000): Influence of mint and peppermint on *Tetranychus urticae* and some predacious mites of the family Phytoseiidae (Acari: Tetranychidae: Phytoseiidae). *Acta Phytopathologica et Entomologica Hungarica* 36, 143–153.
- Momen, F. M., Reda, A. S. and Amer, S. A. A. (1997): Effect of Neem Azal-F on *Tetranychus urticae* and three predacious mites of the family Phytoseiidae. *Acta Phytopathologica et Entomologica Hungarica* 32, 335–362.
- Ragusa, S. and Swirski, E. (1975): Feeding habits, development and oviposition of the predacious mite *Amblyseius swirskii* Athias-Henriot (Acarina: Phytoseiidae) on pollen of various weeds. *Israel J. Agric. Res.* 10, 93–103.
- Ragusa, S. and Swirski, E. (1977): Feeding habits, post embryonic and adult survival, mating, virility and fecundity of the predacious mite *Amblyseius swirskii* (Acarina: Phytoseiidae) on some coccids and mealybugs. *Entomophaga* 22, 383–392.
- Samsøe – Petersen, L. (1983): Laboratory method for testing side effects of pesticides on Juvenile stage of the predatory mite, *Phytoseiulus persimilis* (Acarina: Phytoseiidae) based on detached bean leaves. *Entomophaga* 28, 167–178.
- Swirski, E., Amitai, S. and Dorzia, N. (1967a): Laboratory studies on the feeding, development and reproduction of the predacious mites *Amblyseius rubini* Swirski and Amitai and *Amblyseius swirskii* Athias-Henriot (Acarina: Phytoseiidae) on various kinds of food substances. *Israel J. Agric. Res.* 17, 101–119.