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A Comparative Study of the Effect of Some Mineral and Plant Oils on Two Predacious Mites of the Family Phytoseiidae (Acari: Phytoseiidae)

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The direct toxicity of some mineral and plant oils to adult females of the predacious mites, *Amblyseius barkeri* (Hughes) and *Amblyseius zaheri* Yousef and El-Borolossy were tested. KZ oil was the most toxic to females of *A. barkeri* and *A. zaheri* (LC_{50} = 0.391 and 0.308%, respectively). In contrast, Natur'l oil was relatively intoxic to females *A. zaheri* and *A. barkeri.*

Bio-dux, Capl-2 and Natur'l oils have a close toxic effect for both predacious mites. Females of *A. barkeri* and *A. zaheri* suffered a depression in reproduction when sprayed with conc. = LC_{50} of each oil and kept on plant leaves previously treated with different oils. Laboratory studies indicated that the vegetable oil Natur'l oil was the least effective oil on all biological aspects of both predacious mites *A. barkeri* and *A. zaheri* in the laboratory.

Keywords: Acari: *Amblyseius barkeri, Amblyseius zaheri,* mineral oils, plant oil, Phytoseiidae.

The predacious mites of the family Phytoseiidae have been characterized by their higher potential rate of natural increase compared with their prey, Tetranychidae (Takafuji and Chant, 1976; Saito and Mori, 1981). Biological control of pest insects and mites in greenhouse vegetable crops has traditionally relied on releases of a single, specialist natural enemy for each pest. *Amblyseius* spp. is major predators of phytophagous mites in various agro-ecosystems (Braun et al., 1987 & 1989; Huffaker et al., 1969, McMurtry 1977). *Amblyseius barkeri* (Hughes) is an oligophagous predatory mite, it has been mass-reared with storage mites, such as *Acarus farris* (Oudemans) as prey (Ramakers and van Lieburg, 1982) for control of thrips (*Thrips tabaci* Lindeman) on cucumbers and peppers in many parts of the world (Hansen, 1988; Lindqvist and Tittanen, 1989). It has been reported to control the citrus thrips, *Scirtothrips citri* (Moulton) in Nursery citrus (Grafton-Cardwell et al., 1999) and it can reduce the two spotted spider mite *Tetranychus urticae* Koch. damage on cucumber (Karg et al., 1987).

Amblyseius barkeri was able to feed also on the broad mite, *Polyphagotarsonemus latus* (Banks) on pepper as well as on eriophyid mites *Eriophyes dioscoridis* Soliman and Abou-Awad (Fan and Petitt, 1994; Momen, 1995). *Amblyseius zaheri* Yousef and El-Borolossy is the most widespread phytoseiid species on eggplant in Egypt. *A. zaheri* is an effective agent of biological control, because this predator can survive for extended periods on alternative sources of food when spider mites are scarce (Abou El-ella, 1998). He also observed that the predator was able to feed on pollen grains, scale insects as well as eriophyid mites. The predator was also observed to feed on onion thrips *T. tabaci* in the laboratory (Personal observation).

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The effect of mineral oils on mite pests are limited to citrus red mite *Panonychus citri* (McGregor) and the European red mite *Panonychus ulmi* (Koch.) as well as *Eutetranychus orientalis* (Klein) and *T. urticae* (Riehl et al., 1958; Trammel, 1965; Herron et al., 1995; Osman, 1997; Herron et al., 1998). Amer et al. (2001) studied the direct toxicity of 8 mineral and plant oils to eggs and females of *T. urticae* as well as their effect on some biological aspects of the pest.

Mineral spray oils may kill small natural enemies (e.g. predatory mites, and adult and immature parasitoids) directly by suffocation or indirectly by killing their hosts (Beattie and Smith, 1996). The effect of mineral and plant oils on the predacious mites is not studied extensively yet, therefore this study was undertaken to provide information on the direct and residual effect of some mineral and plant oils on both predacious mites *A. barkeri* and *A. zaheri* in the laboratory.

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. The mites were kept in a controlled climate room at 25–27 ºC and 70 ± 5% R. H.

Material tested

MINERAL OILS

In our experiments we used 7 mineral oils named: Sol EC, Capl-1, Capl-2, KZ-oil, Citrole, Kemesol and Bio-dux.

NATURAL VEGETABLE OIL:

Natur'l oil only was used.

All information about both kind of oils was reported by Amer et al. (2001).

Toxicity bioassay

DIRECT EFFECT ON ADULT FEMALES

Adult females of both predacious mites 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. 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 counts according to Abbott's formula (1925) and were statistically analysed by Finney (1952).

INDIRECT EFFECT ON ADULT FEMALES

The effect of the food-chain toxicity on the reproduction, hatching and mortality of the two predacious mites *A. barkeri* and *A. zaheri* were also studied. Plant leaves were dipped for 50 s in suspensions of different oils at concentrations equivalent to the LC_{50} of the predators and left to dry. Nymphs of the two spotted spider mite *T. urticae* were transferred to the treated leaves and kept for 24 h to ensure that they already have sucked plant juice. Twenty newly emerged and mated females of both predators were sprayed with the above concentrations of each oil and removed to the treated plants. A similar number of females treated with water as control. Discs were provided daily with a sufficient numbers of *T. urticae* nymphs for 7 days. Observations were taken daily on reproduction, mortality, hatchability and sex ratio of the progeny for 7 successive days. All experiments reported herien were carried out in the laboratory at 25–27 ºC and 70–75% R. H. Statistical analysis were carried out using the "F" test. The deterent indices were calculated as reported by Lundgren (1975).

Results and Discussion

Direct effect on adult females

Figures 1 and *2* show the relation between the percentage of mortality and the concentrations of some mineral and vegetable oils on adult females of *A. barkeri* and *A. zaheri.* The data obtained in Table 1 shows that KZ-oil was the most toxic to females of *A. barkeri* and *A. zaheri* (LC_{50} = 0.391 and 0.308%, respectively).

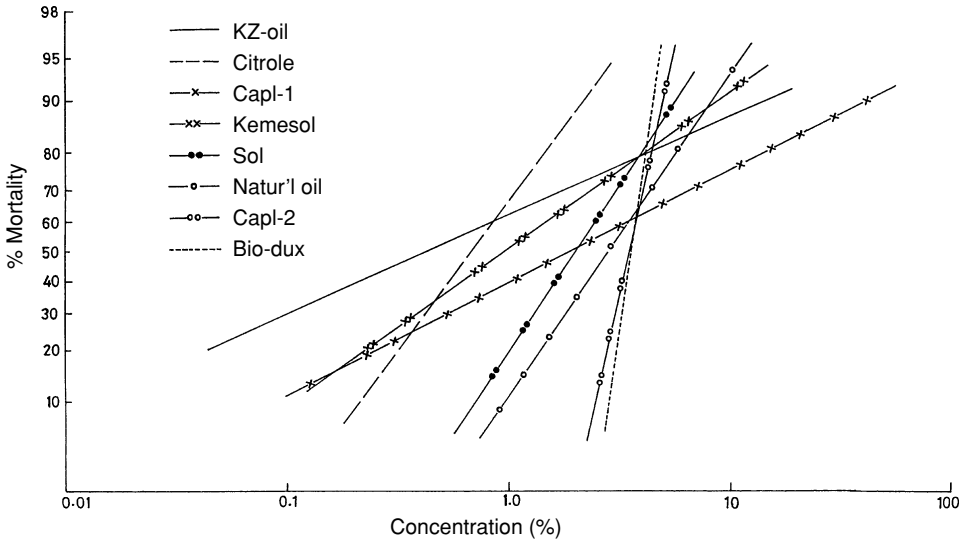

Fig. 1. Toxicity of some mineral and vegtetable oils against adult females of the predacious mite *A. bakeri*

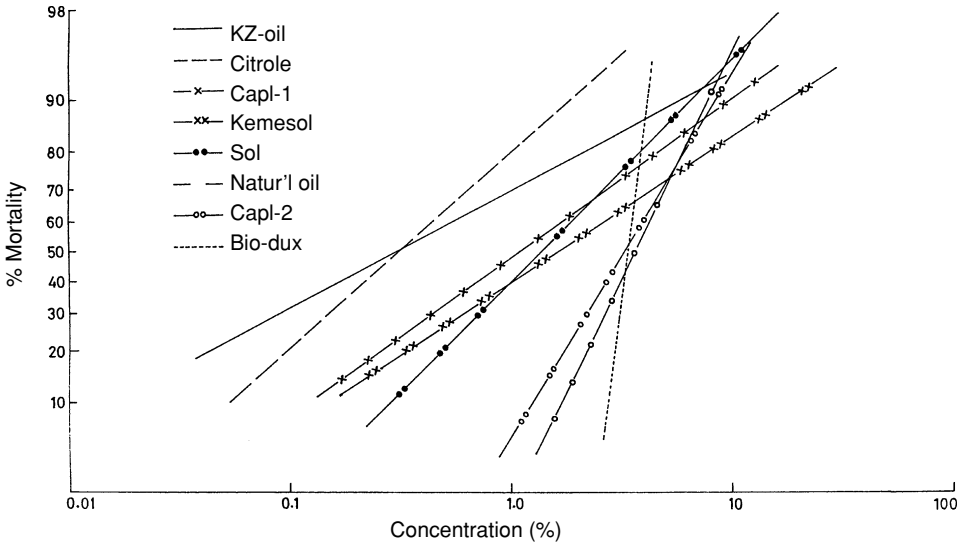

Fig. 2. Toxicity of some mineral and vegtetable oils against adult females of the predacious mite *A. zaheri*

The LC50 values of the tested oils toxicity *(A. barkeri)* were in descending order of effectiveness as follows: KZ-oil, Citrole, Kemesol, Capl-1, Sol, Natur'l oil, Capl-2 and Bio-dux while the values for *A. zaheri* were as follow: KZ-oil, Citrole, Capl-1, Sol, Kemesol, Capl-2, Bio-dux and Natur'l oil. Previous studies by Amer et al. (2001) showed that the following mineral oils: Kemesol, Capl-1 Sol, Citrol, KZ and Capl-2 were more efficacious to eggs of *Tetranychus urticae* than that to females of *A. barkeri* and *A. zaheri* (present study). In contrast the least effect of the above-mentioned oils was on adults of

Table 1

Toxicity of some mineral and vegetable oils to the females of *A. barkeri* and *A. zaheri*

Materials	LC_{50}%			
	T. urticae * Eggs	*T. urticae* * Adults	*A. barkeri* Adults	*A. zaheri* Adults
KZ-oil	0.20	5.731	0.391	0.308
Citrole	0.232	0.975	0.686	0.318
Sol	0.579	3.878	2.005	1.37
Capl-1	0.618	3.195	1.892	1.106
Kemesol	0.638	1.055	0.993	1.643
Capl-2	0.878	4.336	3.532	3.248
Natur'l oil	1.494	2.055	2.866	3.704
Bio-dux	11.46	4.812	3.634	3.704

* Amer et al. (2001)

T. urticae (Table 1). The Natur'l oil was more efficacious on eggs of *T. urticae* followed by adults of *T. urticae* and the least for both predacious mites *(Table 1).* Research carried out by Momen and Amer (1999) and Momen et al. (2001) revealed that both rosemary and peppermint oils were more toxic to *A. barkeri* than marjoram and mint oils, but the latters were toxic to *A. zaheri.* It worth is mentioned also that peppermint oil was intoxic to *A. zaheri* compared to *A. barkeri* (LC_{50} 25.27% compared to 3.72%).

Indirect effect on adult females

The possibility of transmitting residues to *A. barkeri* and *A. zaheri* through *T. urticae* fed on treated leaves with different mineral and plant oils for 24 h was examined in this work. The fecundity of *A. barkeri* and *A. zaheri* females consuming pry fromerly reared on leaves treated with different mineral oils 24 h were much less than that on the control *(Tables 2 and 3).*

Momen et al. (1997) demonstrated that Neem Azal-F appeared to be harmless for both predators *A. barkeri* and *A. zaheri.* Research carried out by Momen and Amer (1994) demonstrated that *A. barkeri* suffered a drop in reproduction when fed on prey kept on treated leaves with lupine, turnip and fenugreek extracts.

Similar significant reduction in the total number of eggs laid/female for both species was reported when sprayed with rosemary oil at 1% conc. (Momen and Amer, 1999).

The results also revealed that egg hatchability was 100% for both predators in case of Natur'l, citrole, kemesol oils, but it was affected in case of Bio-dux *(A. barkeri),* capl - 1 and capl-2 *(A. zaheri) (Tables 2* and *3).* All mineral and vegetable oils used were caused (15 – 66.67%) and (26.67–50%) mortalities, respectively, on adult females of *A. barkeri* and *A. zaheri* after 1 week treatment *(Tables 2* and *3).*

Table 2

Effect of some mineral and vegetable oils on the reproduction, mortality and sex-ratio of the progeny treated females of *A. barkeri* fed on *T. urticae* formerly kept on treated and untreated substances

Materials	Total No. of egg/female /7days	Total No. of egg/female /day ± S. E.	% M female after 7 days	% ODI	% Hatching of eggs	Sex ratio male: female
KZ-oil	3.4	0.49±0.15	15	62.12	98.53	1:2.4
Capl-1	3.5	0.50±0.09	33.33	61.67	86.84	1:2.29
Sol	2.2	0.31±0.11	53.33	73.95	100	1:2.5
Capl-2	2.1	0.30±0.08	46.67	75.30	87.5	1:2.83
Bio-dux	3.8	0.54±0.06	15	59.02	74.67	1:2.5
Natur'l oil	5.1	0.73±0.08	33.33	48.09	100	1:2.67
Citrole	1.3	0.19±0.06	66.67	83.60	100	1:2.2
Kemesol	1.2	0.17±0.05	66.67	84.76	100	1:2.33
Control	14.6	2.09±0.025	0	–	100	1:3.36
L.S.D 0.05		0.334				
0.01		0.445				

M = Mortality

Table 3

Effect of some mineral and vegetable oils on the reproduction, mortality and sex-ratio of the progeny treated females of *A. zaheri* fed on *T. urticae* formerly kept on treated and untreated substances

Materials	Total No. of egg/female /7days	Total No. of egg/female /day ± S. E.	% M female after 7 days	% ODI	% Hatching of eggs	Sex ratio male: female
KZ-oil	2.7	0.39±0.09	50	69.49	87.5	1:1.5
Capl-1	1.4	0.20±0.06	33.33	82.93	77.78	1:2
Sol	1.6	0.23±0.07	46.67	80.72	91.67	1:1.75
Capl-2	2.5	0.36±0.06	33.33	71.43	72.50	1:1.5
Bio-dux	3.5	0.50±0.06	26.67	62.60	90.74	1:1.7
Natur'l oil	3.1	0.44±0.05	26.67	65.75	100	1:2.5
Citrole	2.7	0.39±0.07	40	69.49	100	1:1.5
Kemesol	3.1	0.44±0.05	26.67	65.75	100	1:2.33
Control	15.0	2.14±0.25	0		100	1:3.18
L.S.D 0.05		0.297				
0.01		0.395				

M = Mortality

Conclusion

Our results indicated that Natur'l oil which was toxic to the pest *T. urticae* (eggs and adult females) (Amer et al., 2001) and it was cosidered to be satisfactory for both predacious mites *A. barkeri* and *A. zaheri.* The following oils, kemesol, capl-1, capl-2, sol, citrole and KZ were considered to be ovicidal for *T. urticae* (present study and Amer et al., 2001). Both predacious mites, *A. barkeri* and *A. zaheri* are key predators of spider mites in vegetable fields (Momen 1995; Abou El-ella, 1998).

Therefore the work presented here is based on laboratory data, which are not always directly transferable to the field, so field trials are therefore necessary to determine the effect of Natur'l oil will have on both predators in crop fields.

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