APHICIDAL ACTIVITY OF SOME PLANT EXTRACTS AND ESSENTIAL OILS AGAINST GREEN PEACH APHID, *MYZUS PERSICAE* (SULZER) (HOMOPTERA: APHIDIDAE)

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INTRODUCTION

The use of chemical insecticides for controlling the major pests has created important problems such as the environmental pollution and pest resistance. Therefore, it has become necessary to look for safe insecticides. Recently, attention has been given to the isolation and identification of various botanical compounds, possessing insecticidal properties from plant sources. Plant extracts attracted the attention of entomologists because most botanical extracts are not toxic to warm-blooded animals and show no/or moderate side effect on natural enemies (Schmutterer 1990). Several attempts have been made to monitor the insecticidal activity and other insecticidal effects in extracts of different plant species against various insects (Ahmed 1993 and Barakat *et al.*, 1985). The plant crude extracts were utilized in pest control (Ramadan 1987; Blaske and Hertel 2001 and Soliman *et al.*, 2003).

The essential oils have received much attention as resources of potentially useful bioactive compounds. Particular emphasis has been placed on their antimicrobial, antifungal, antitumor and insecticidal action as well as on their action on the central nervous system (Greasimos *et al.*, 1997). The effects of the essential oils on insects range from an attraction or repellence to that of toxicity or even lethality. Even though the use of insecticidal plants is known from antiquity, only a few of these are commercially available (Balandrin and Klocke 1988). The present study aims to study the toxicity of the crude extracts of some wild plants and plant essential oils against field strain of the green peach aphid, *Myzus persicae* (Sulzer) under laboratory conditions.

MATERIAL AND METHODS

Twelve different plants belonging to 6 families, which are well known to have bioactive components against harmful pests, were used in the present study.

These plants were collected from different localities throughout the Egyptian deserts. Plant identity, locations and their extracted parts are shown in Table (1).

Plant extracts were prepared according to the method described by Freedman *et al.*, 1979 and Su and Horvat 1981 with the following modifications. Samples (1 kg of each fresh plant materials) were blended and soaked in 3 liters of ethanol for 24 hours and kept in brown colored bottles, 5 liters, provided with tight stoppers with continuous shaking for overnight. The solvent extract was separated from the plant materials and the later re-extracted with 2 liters of the same solvent for 12 hours. The collected two extracts (5 liters) were filtered over anhydrous sodium sulphate and then the solvent was evaporated under reduced pressure using a Rotary evaporator.

The ethanol crude extract was filtered over anhydrous sodium sulphate and the solvent was evaporated using rotary evaporator at 40–50 °C to dryness. The resulting crude extract was weighted and kept in the deep freezer until evaluation.

Five plant essential oils extracted from plants belong to family, Labiatae were used in the present study. These plants were *Lavandula officinalis*, *Marjorana hortensis Ocimum basilicum, Mentha virids* and *Mentha piperta*. Oils were prepared from plants by submitting the air-dried herb of each plant to stem distillation for 3 hours in a Clevenger apparatus (Soliman, 2001). The oil collected from each was dehydrated over anhydrous sodium sulphate.

Samples of cabbage and eggplant leaves infested with green peach aphid, *Myzus persicae* (Sulzer) were collected from a private farm in Qalubyia Governorate. Slide-dipping technique was used to evaluate the toxicity of the tested plant extracts and essential oils against the adult stage. A serial concentration of each plant extract or plant essential oil was prepared by dissolving it in water and ethanol (9: 1 v/v) and 0.05 % Triton–X 100. By means of fine brush, ten adults were affixed to double face scotch tap and stuck tightly to a slide on the dorsal part. The slides were then dipped in the prepared extract or essential oil aqueous solutions for ten seconds. Five different concentrations were used for each plant extract or essential oil. Five replicates (ten adults on each slide) were used for each concentration. Control test was carried out using the same technique but the slides were dipped in water mixed with 0.1 % ethanol in case of crude extracts and 0.05 % Triton – X 100 of the essential oils. Mortality was recorded two hours after treatment and all insects that responded to touching with the fine brush were considered alive. Mortality data were corrected according to Abbott's formula (1925) then subjected to statistical analysis by the method of Busvine (1957). The toxicity index of each plant extract or essential oil was determined according to Sun (1950) as follows:

$$\text{Toxicity index} = \frac{\text{LC50 or LC90 of the most effective insecticide}}{\text{LC50 or LC90 of the less effective insecticide}} \times 100$$

RESULTS AND DISCUSSION

The use of ethanol in the extraction of plant gave high toxicity to seven plants. The non toxic effect of the organic solvent ethanol on insects was recorded by several investigators, Omura and Honda (2003) reported neither ethanol nor acetic acid solely evoked continuous feeding responses in *Kaniska canace* and *Vanessa indica.* Although high concentrations of ethanol and acetic acid serve as olfactory stimuli to evoke the proboscis extension reflex in both species, such clear responses were not observed in their bioassays. Bokor and Pecsenye (1998) compared the effect of ethanol on larva-to-pupa and larva-to-adult survival in ten laboratory strains of Drosophila melanogaster. Second instar larvae of all ten strains were exposed to different ethanol treatments and larva-to-pupa and larva-to-adult survival components were estimated. They found that the three Odh genotypes tolerated exogenous ethanol differently: Odh super (F) homozygotes had the highest tolerance to ethanol in both the larval and pupal stages. Temeyer (1998) evaluated the toxicity of ethanol methanol, dimethylsulfoxide (DMSO) and dimethylformamide (DMF). DMSO and DMF were incompatible with horn fly larvae at all concentrations tested. Methanol and ethanol were each tolerated to about 2 % (vol/wt), but exhibited increasing toxic effects at higher concentrations. Ethanol supplementation up to 2 % had a positive effect on larval growth and survival.

Data presented in Table (2) and Fig. (1) show the efficiency of the ethanol extract of tested plants against green peach aphid, *M. persicae* . The ethanol crude extract of *C. droserifolia* was the most effective extract whereas *T. hirsuta* was the least one. On basis of LC_{50} the tested plant extracts could be classified into three categories. The first category contained one plant extract that showed high toxic action (LC_{50} 2.30 mg/ml) e.g. *C. droserifolia*. The second category included five plant extracts, which gave considerable toxic effect. These plants could be arranged according to their LC_{50} following descending order, *A. monosperma* (9.93 mg/ml), *E. aegyptiaca* (10.30 mg/ml), *A. melanopodia* (13.30 mg/ml), *F. crispa* (15.14 mg/ml) and *R. hirtella* (17.17 mg/ml). The third category is *T. hirsuta* extract (33.75 mg / ml) which gave low toxic effect (Fig. 1).

Comparing the slope values of toxicity lines of these plant extracts as shown in Table (2), it is evident that *T. hirsuta* and *C. droserifolia* showed the flatted one (1.91 and 1.94), whereas *F. crispa* showed the steepest toxicity line (slope = 3.96). Results indicate that the toxicity indexes of such group of toxicant at the same arrangement of LC_{50} levels were 23.16, 22.33, 17.29, 15.19, 13.40 and 6.81 % whereas *C. droserifolia* was the most potent extract 100 %.

TABLE (I)

Identification of collected plants used for extract preparation

Family	Plant	Part used in extraction
Crude extracts		
Cleomaceae	*Cleome droserifolia*	Whole plant
Compositae	*Artemisia monosperma*	Whole plant
	Anthemis melanopodia	Whole plant
	Francoeuria crispa	Whole plant
Euphorbiaceae	*Euphorbia aegyptiaca*	Whole plant
Tmaraciaceae	*Reaumaria hirtella*	Leaves and stem
Thymelaeaceae	*Thymelaea hirsuta*	Leaves and stem
Essential oils		
Labiatae	*Lavandula officinalis*	Aerial parts
	Ocimum basilicum	Aerial parts
	Marjorana hortensis	Aerial parts
	Mentha virids	Aerial parts
	Mentha piperta	Aerial parts

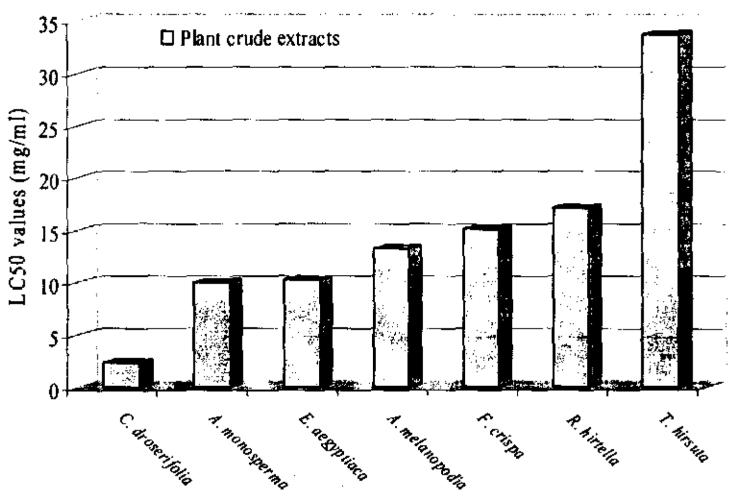

Fig. (1): Toxicity of certain wild plant crude extracts against *M. persicae*

Qing *et al.* (2003) tested the insecticidal activity of the crude extract of *Peganum harmala* against *Lipophis erysimi* and *Spodoptera littoralis*. The methanolic extract of *P. harmala* at 1000 *u*g/ml recorded 93.07 % and 96.36 % mortality of the turnip aphid (*L. erysimi*) at 24 and 48 hrs after the treatment, respectively. Using the leaf disk method, the antifeedant rates of methanolic extract of *P. harmala* at 1000 *u*g /ml were 90.80 % and 72.13 % respectively, against the 5^{th} instar larvae of *P. rapae* and the 3^{nd} instar larvae of *S. littoralis* after 24 hr.

TABLE (II)

Toxicity wild plants crude extracts against green peach aphid, *Myzus persicae*

Plant extract	LC_{50} mg /ml	LC_{90} mg/ml	Slope ± SE	Toxicity index at:	
				LC_{50} mg/ ml	LC_{90} mg/ ml
Cleome droserifolia	2.30	10.53	1.94 ± 0..36	100	100
Artemisia monosperma	9.93	39.59	2.13 ± 0.26	23.16	26.59
Euphorbia aegyptiaca	10.30	42.22	2.09 ± 0.36	22.33	24.94
Anthemis melanopodia	13.30	47.97	2.34 ± 0.41	17.29	21.95
Francoeuria crispa	15.14	31.93	3.96 ± 0.70	15.19	32.97
Reaumaria hirtella	17.17	70.32	2.09± 0.36	13.40	14.97
Thymelaea hirsuta	33. 75	158.53	1.91± 0.43	6.81	6.64

Soliman *et al.*, (2005) concluded that the extraction with ethanol of 14 plant extracts induced high toxicity in the apterous adults of the cotton aphid, *Aphis gossypii* (Glov.) with LC_{50} values which varied from 1.143 mg /ml to 4.831 mg/ml. They added that ethanol extracts of *Rumex dentatus* and *Stochys aegyptiaca* gave the highest toxic effect.

On the other hand, Saleh *et al.*, (1986) investigated the insecticidal activity of 53 plant species from 23 different families against, *Musca domesticate*, *Spodoptera littoralis*, *Tribolium confusum*, *Callosobruchus maculates*, *Rhizopertha dominica* and *Sitophilus oryzae*. Fresh plants were directly extracted in ethanol. The remained aqueous layer was then extracted using organic solvents of variable polarities. They found that the nonpolar (petroleum ether) extracts were the most effective for contact toxicity where a compound must be relatively lipophylic to penetrate insect cuticle.

The results in Table (3) and Fig. (2) show the efficiency of the tested plant essential oils against the apterous adults of *Myzus persicae*. All experimental oils gave toxic effect except with *M. piperta*, which was the least one. *L. officinalis* was the most effective essential oils followed by *O. basilicum*, *M. hortensis*, *M. virids* and *M. piperta*. The LC_{50} values were 27.69, 76.63 94.09, 288.63 and 1069.34 ppm, respectively. Based on the LC_{50} values, the tested plant essential oils against *Myzus persicae* could be divided into three groups. The first one revealed high aphicidal activity, which was represented by *L. officinalis*, the LC_{50} was 27.69 ppm. The second group represents 2 plant oils (*O. basilicum* and *M. hortensis*) which showed satisfactory aphicidal activity (LC_{50} were 76.63, 94.09 ppm, respectively). The third group contained *M. virids* and *M. piperta* which had low aphicidal activity (LC_{50} were 288.63 and 1069.34 ppm, respectively). Comparing the slope values of toxicity lines of these plant oils, it is evident that the five plant essential oils showed the flatted toxicity lines (slopes values ranged between 1.69 and 0.68).

TABLE (III)

Toxicity of plant essential oils against green peach aphid, *Myzus persicae*

Plant essential oil	LC_{50} (ppm)	LC_{90} (ppm)	Slope ± SE	Toxicity index at:	
				LC_{50}	LC_{90}
Lavandula officinalis	27.69	386.90	1.12 ± 0.21	100	100
Ocimum basilicum	76.63	437.77	1.69 ± 0.34	36.13	89.07
Marjorana hortensis	94.09	574.88	1.63 ± 0.42	29.43	67.30
Mentha virids	288.63	22613.89	0.68 ± 0.18	9.59	1.71
Mentha piperta	1069.34	14263.03	1.14 ± 0.4	2.59	2.71

Toxicity of these oils attributed to the presence of terpine compounds. These compounds differ from one to another oil. Amer *et al.* (2001) showed that *Margorana hortensis* oil had toxic effect on two spider mites *Tetranychus urticae* and *Eutetranychus orientalis*. They also added that the main compounds of this oil were Y-terpiene and Sabinen + B-pincen. However, Refaat *et al.* (2002) revealed that *O. basilicum* and *L. officinalis* affected *Tetranychus urticae* and *Eutetranychus orientalis*. They also referred to main compounds of these oils, chavicol and 1,8-cineol in *O. basilicum* and linolyl acetic and linalool in *L. officinalis*. Moreover, Momen *et al.* (2001) reported that *M. virids* and *M. piperta* had toxicity on *Tetranychus urticae*. They also mentioned that corvine *O. limonene* was the main compound in *M. virids*.

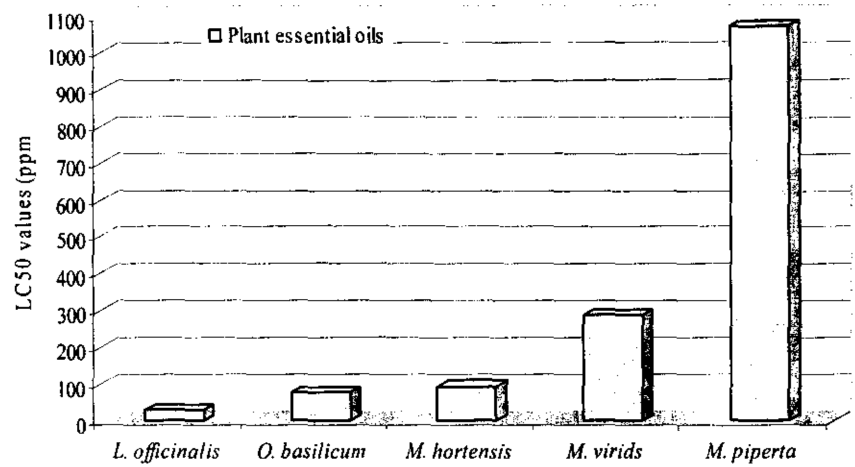

Fig. (2): Toxicity of certain plant essential oils against *M. persicae*

Channo *et al.* (2002) found that *Eucalyptus camaldulensis* oil had toxic effect on *Sitophilus zeamais* and *Tribolium castaneum* insects. They also added that the toxic effect of this oil may be attributed to the two major compounds (1,8-Cineol and Y-terpiene). The compound 1,8-Cineol affected larvae of *T. castaneum* (Tripathi *et al.*, 2001). Methanol killed 100 % of the mite *Tyrophagus loagior* at the lowest dose (0.25 *u* / ml) by direct contact (Perrucci 1995).

Harwood *et al.* (1990) reported that about 0.2 % menthone led to 37 % mortality of larvae of the cutworm *Peridrome saucia.*

In conclusion, these essential oils had toxic effect on adults of *Myzus persicae* except *M. piperta,* which was the least toxic. More studies are needed to confirm the insecticidal activity of these plant extracts.

SUMMARY

Seven crude extracts of wild plant species and five plant essential oils were investigated for their activity against apterous adults of the green peach aphid, *Myzus persicae* (Sulzer). Plant extracts were obtained by extracting fresh plants with ethanol.

Ethanol crude extracts gave high toxicity to seven plant extracts, with LC_{50} varied from 2.30 to 33.75 mg/ml. *Cleome droserifolia* ethanol extract induced superior toxicity followed by *Artemisia monosperma*, *Euphorbia aegyptiaca, Anthemis melanopodia*, *Francoceria crispa* and *Reaumaria hirtella*. The LC_{50} values were 2.30, 9.93, 10.30, 13.30, 15.14 and 17.17mg/ml, respectively. *Thymelaea hirsuta* was the least effective one (LC_{50} 33.75 mg/ ml).

As for five plant essential oils, the results indicated that *Lavadula officinalis* was the most effective followed by *Ocimum basilicum*, then *Margorana hortenisi* and *Mentha virids* while *Mentha piperta* was the least effective oil. The LC_{50} values were 27.69, 76.63, 94.09, 288.63 and 1069.34 ppm, respectively.

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