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Full Length Research Paper

Evaluation of some medicinal and ornamental plant extracts toward pomegranate aphid, *Aphis punicae* (Passerini) under laboratory conditions

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Ethanol and water extracts of five medicinal and ornamental plant species namely, *Aerva lanata*, *Ruta chalepensis, Fagonia arabica, Malva parviflora,* and *Calotropis procera;* were evaluated against pomegranate aphid, *Aphis punicae* Passerini under laboratory condition. Results indicated that the ethanol extract of *R. chalepensis* (whole plant) showed the highest repellency (75) and mortality (79.5) at 0.015% concentration. Followed by ethanol extract of *A. lanata* which elicited high repellent effect (60.68%) and moderate mortality percentage (55.54%) at 0.015% concentration. On the other side, water extracts of *A. lanata* caused the highest repellency (44.88%) and mortality (61.2%) at 5% concentration. Followed by *M. parviflora* which induced slight repellency (36.22%) and mortality (51.5%) at 5% concentration.

Key words: Pomegranate aphid, *Punica granatum,* plant extracts, repellent, mortality.

INTRODUCTION

The pomegranate tree, *Punica granatum* is attacked by several insect species which decrease the quality and quantity of its product. Aphids are among the most serious and widespread pests in pomegranate orchards. Both adults and nymphs feed on leaves, inflorescences and fruits. Infestation with aphids result in pale and curled leaves; retard development and fallen flowers; besides it transmit viral diseases and secret honey dew on which fungi grow. Aphids have a high reproductive capacity and extensive usage of insecticide to control them results in the development of resistance (Garg et al., 1987; Udaeen and Narang, 1988; Khurana and Batra, 1989; Zheng et al., 1997; Pavela et al., 2009). That forced many researchers to find out new and effective methods for safe control of aphids. Plant extracts are the recent trend which elicited effect against aphids in the field (Endersby and Morgan, 1991) and under laboratory conditions (Sweeden and McLeod, 1997; Liang, 2003; Görür et al., 2008). The objective of this work was to study the efficiency of different plant extract against pomegranate aphids under laboratory conditions.

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MATERIALS AND METHODS

Viviparous females of the pomegranate aphids were collected from pomegranate trees located at the Faculty Farm of Growa, El-Taif University, Saudi Arabia. Five plant species were selected. Dried materials were extracted with two solvents (water and alcohol) according to Chitra et al. (1993). Scientific names and the parts of plant used for extraction are listed in Table (1). Three concentrations were prepared (0.003, 0.005 and 0.015% for ethanol and 1.5, 2.5 and 5% for water extract) from the previous mentioned plants. Laboratory experiments were carried out as follows:

1. Choice test: Repellency effect of three concentrations of alcoholic, as well as water plant extracts were tested. For each test, two leaves of the same size were selected, from disinfested pomegranate tree and washed in running water and then swapped by cotton pieces. After that, one leaf was dipped for 5 min in the corresponding plant extracts and left to dry. Petri-dishes (10 cm in diameter), bottom lined with a filter paper were divided into two equal parts. Treated leaves were placed in one side and untreated ones on the opposite one. Available numbers of aphids (wingless in mother stage) individuals "not less than 8 individuals in each test" at the center of the dish and left for 24 h and then numbers of aphids in each side were recorded. Each test was replicated five times. Percentage of repellency was calculated according to the following equation:

Repellency % = (No. of individuals in untreated area – No. of individuals in treated area) / total numbers of individuals ×100

Table 1. List of medicinal and ornamental plant extracts tested against pomegranate aphids.

Extracted part	Family	Scientific name
Leaves and whole plant	Amaranthaceae	*Aerva lanata*
Whole plant	Rustaceae	*Ruta chalepensis*
Whole-plant	Zygophyllaceae	*Fogonia arabica*
Leaves- Flowers	Malvaceae	*Malva parviflora*
Leaves	Asclepiadaceae	*Calotropis procera*

Table 2. Repellency effect of different ethanol plant extracts on the pomegranate aphids.

Tested plant extracts	Concentration (%)	Repellency (%)
Aerva lanata (leave)	0.003	8.64^{aa}
	0.005	36$^{aa.}$
	0.015	60.68$^{cc'}$
Ruta chalepensis	0.003	32.14^{xa}
	0.005	52.00$^{xc.}$
	0.015	75.00^{yc}
Fagonia Arabica	0.003	-20.40^{na}
	0.005	-3.18$^{na.}$
	0.015	- 2.22^{na}
Malva parviflora	0.003	38.3^{kc}
	0.005	41.46$^{kb.}$
	0.015	55.54^{kb}
Calotropis procera	0.003	-2.22^{ea}
	0.005	-5.14$^{ea.}$
	0.015	14.46$^{ea'}$
Statistical analysis	L.S.D.$_{0.05}$ = 36.006; L.S.D.$_{0.01}$= 48.5	

Numbers with the same letters have no significant difference (P >0.05). (-) The plant extract has negative repellency effect.

The statistical analysis was calculated according to one way Anova.

2. Non-choice test: Pomegranate leaves were treated as previously mentioned with the same extracts. The test was carried out by releasing 20 individuals of aphids (in mother stage) directly on the treated leaf at a plastic Petri-dish (10 cm in diameter). After 24 h, percentage of mortality was recorded. Mortality percentage was corrected in each case according to Abbott's formula (1925). Each test was replicated five times.

RESULTS

Repellency effect of plant extracts

Results in Table 2 indicated that all tested ethanol plant extracts, except *Fagonia arabica* caused different levels of repellency which increased with increasing the extract concentration from 0.003 to 0.015%. This was most obvious in treatment with *Ruta chalepensis* and *Aerva lanata* plants. Statistical analysis, within the tested concentrations, proved that ethanol extracts of those plants at the 0.015% concentration scored the highest significance (P<0.01) repellency effects, being about 75 and 61% repellency, respectively. While ethanol extract of *Malva parviflora* showed almost moderate significant difference (P<0.05) in repellency effects which ranged between 38 to 56% at 0.003 to 0.015% concentrations, respectively. The remaining ethanol plant extracts showed slight insignificant variation (P<0.05) in the mean repellency effects on pomegranate aphids. Data in Table 3 cleared that increasing aqueous extract concentration in all cases, caused slight to moderate increase in repellency percentages toward aphids. However, exposure

Table 3. Repellency effect of different water plant extracts on the pomegranate aphids.

Tested plant extracts	Concentration (%)	Repellency (%)
Aerva lanata (leave)	1.5	32.3$^{ac\sim}$
	2.5	36.1$^{ac.}$
	5	44.88 $^{ac'}$
Ruta chalepensis	1.5	9.52$^{x\ a\sim}$
	2.5	16 $^{xa.}$
	5	23.58 $^{xa'}$
Fagonia arabica	1.5	-26.66 $^{ka\sim}$
	2.5	-13.96$^{k\ a.}$
	5	-5.22$^{k\ a'}$
Malva parviflora	1.5	28.78 $^{nc\sim}$
	2.5	36.22$^{nc.}$
	5	56$^{nc'}$
Calotropis procera	1.5	4.62$^{mb\sim}$
	2.5	6.14$^{ma.}$
	5	10.6 $^{ma'}$
Statistical analysis	L.S.D.$_{0.05}$ = 29.4; L.S.D.$_{0.01}$= 38.9	

Numbers with the same letters have no significant difference (p >0.05). (-) The plant extract has negative repellency effect.

of aphids to 1.5, 2.5 and 5% concentrations of *A. lanata* and *M. parviflora* water extract, recorded highly significant variation (P<0.01), ranged between 28 and 56%, respectively comparing with the same concentrations of *F. Arabica* extract with average of repellency ranged between -26.66 and -5.22%, respectively.

Lethal effect of plant extracts

Figure 1 illustrates that ethanol extract of *R. chalepensis* elicited the highest mortality percentages, reaching to 79.5, 72.4 and 72.1% at 0.015, 0.005 and 0.003%, respectively. *A. lanata* extract caused moderate percentages of mortality, reaching to 55.3, 50.9 and 44.2% at 0.015, 0.005 and 0.003 concentrations, respectively. Slight lethal effects were obtained after treatment with ethanolic extract of *F. arabica*, recording 39.4 and 34.4 at 0.015 and 0.005%, respectively. The rest of the extracts of *M. parviflora*, and *Calotropis procera* showed low levels of lethality, ranged between 5.9 and 13.6% at 0.015 and 0.005% respectively.

Figure 2 shows that water extracts of *A. lanata* scored reasonable mortality, ranged from 61.2 to 50.9% at 5 and 2.5%, respectively. Followed by *M. parviflora* which achieved 43.6 and 51.5% at 2.5 and 5%, respectively. The remaining water plant extract of *R. chalepensis*, *F. arabica* and *C. procera* caused low mortality, ranged between 15.9 to 39.4% at 2.5 and 5% toward pomegranate aphids, respectively.

DISCUSSION

In the last decade, hundreds of plants have shown insecticidal property, only few compounds like Azadirachtin (known to disrupt the action of moulting hormone) and pyrethroids (brings about paralysis of the insects) have been commercialized. However, an understanding of structure-activity relationship and knowledge on the mode of action is required for large-scale production. In the present study, non-choice bioassay was followed for assessing the insecticidal activity of the different plant extracts; while choice bioassay was carried out to describe its interaction with insect.

Usually larger doses of plant extracts inflict mortality either by inhibiting feeding or reducing digestibility or inhibiting growth. Smaller doses of extracts may not be adequate for killing the insects; however, it may sometimes induce malformation (Ahmad, 2007). So, it could be concluded that the alcohol extract of *R. chalepensis* (whole plant) and *A. lanata* (leaves) illustrated the better repellency and mortality effects

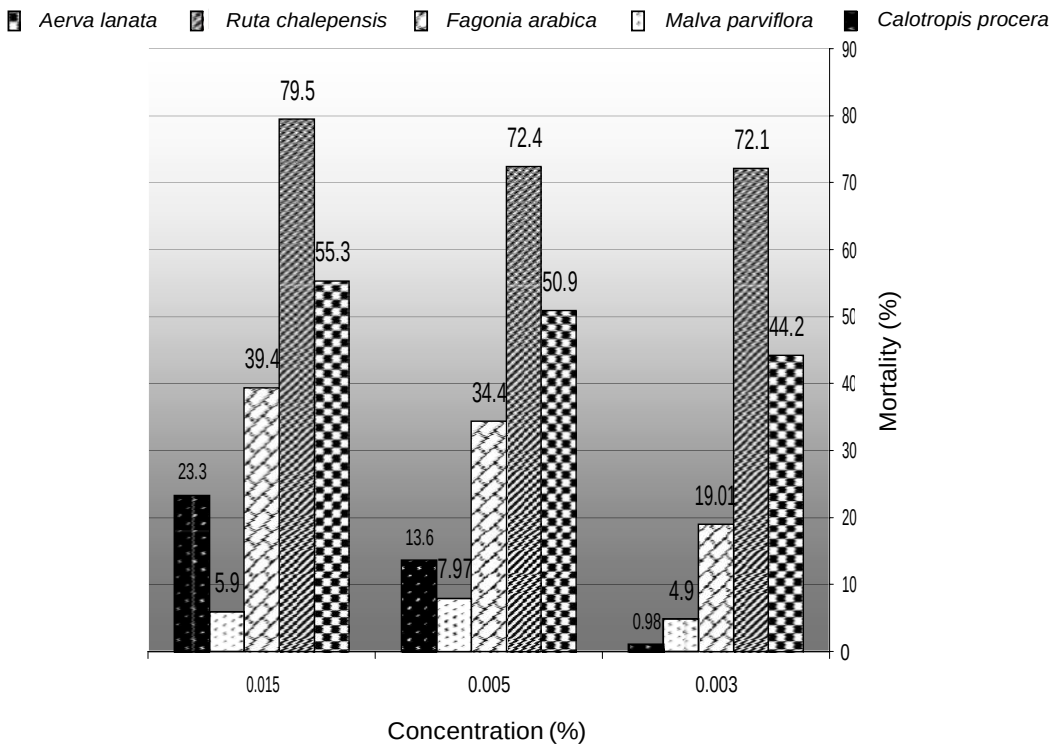

Figure 1. Mortality percentage of ethanol plant extracts on pomegranate aphids.

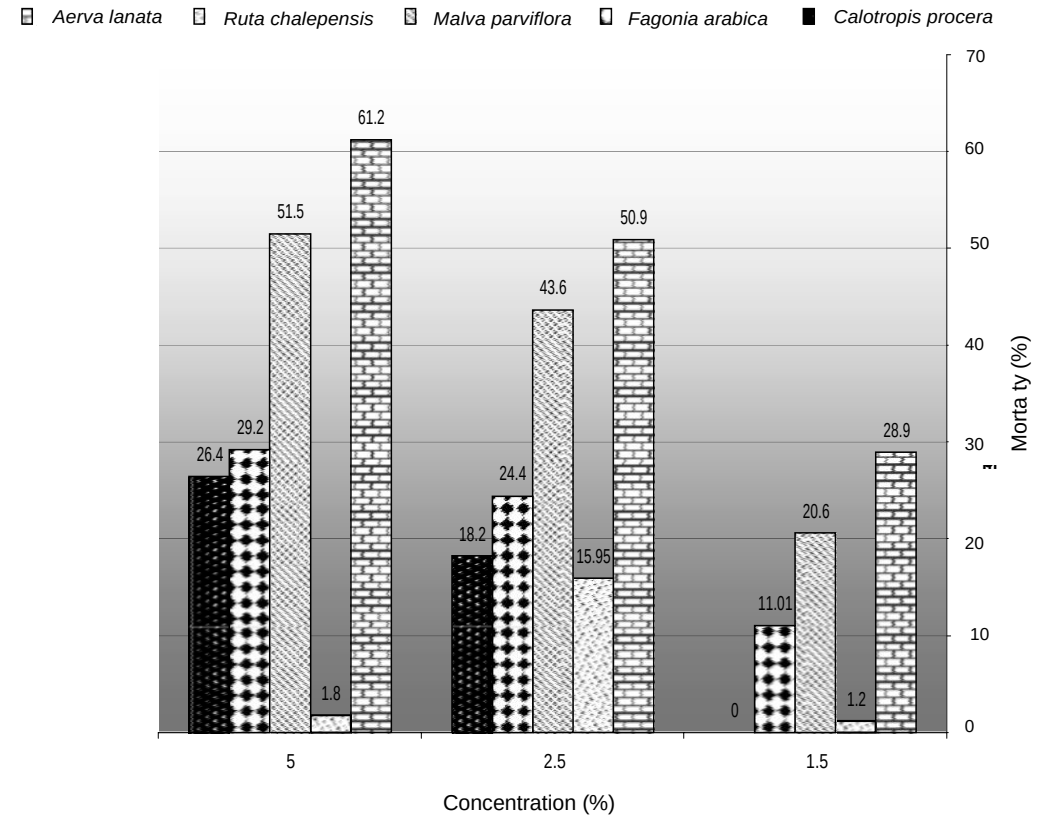

Figure 2. Mortality percentage of water plant extract on pomegranate aphids.

toward pomegranate aphids more than their water extracts. These effects might be related to active ingredients group which was separated by the used solvents. This study could contribute to the assessment of possibility of using medicinal plants as alternative insecticides (Pavela, 2007).

Many authors tested the medicinal and ornamental plant extracts toward different aphid species. Das et al. (2008) tested aphidicidal activity of hot and cold water extracts of some indigenous plants, *Azadirachta indica* A. Juss (neem), *C. procera* (Aiton) W.T. Aiton (akanda), *Polygonum hydropiper* L. (biskatali) and *Ipomoea sepiaria* J. Koenig ex Roxb. (bankalmi), against the bean aphid, *Aphis craccivora* Koch. and found that hot water extracts of *P. hydropiper* and *A. indica* were found to be highly effective.

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