INSECTICIDAL EFFECT SOME PLANT EXTRACTS ON *MYZUS PERSICAE* SULZER (HEMIPTERA: APHIDIDAE)

Pervin Erdoğan* and Ayşegül Yıldırım**

* Plant Protection Central Research Institute, 06 172 Yenimahalle-Ankara, TURKEY. E-mail: pervinerdogan@gmail.com
** Plant Protection Central Research Institute, 06 172 Yenimahalle-Ankara,TURKEY (Retired). E-mail: sallioglua@hotmail.com

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ABSTRACT: Green peach aphid, (*Myzus persicae* Sulzer) (Hemiptera: Aphididae), is a very important pest causing serious damage to vegetables, flowers and fruit crops. The efficacy of extracts from four plants namely *Melia azedarach* L. (Meliaceae), *Veratrum album* L. (Melanthiaceae), *Rhododendron luteum* Sweet (Ericaceae), and *Helichrysum arenarium* L. (Asteraceae) was tested in a search for alternative insecticides. Bioassays were conducted by two different methods to determine the effects of different concentrations. Experiments were performed using 30 mm diameter leaf discs from radish plants, *Raphanus sativus* L. (Brassicaceae). Each treatment and control were replicated ten times. As a result of the investigation, in the leaf dipping method, the extract of *M. azederach, V. album, R. luteum* and *H. arenarium* caused 94%, 67%, 65% and 61% nymph mortality respectively at 12% concentration. The mortalities of adults at the same concentrations were 91%, 85.71%, 57% and 61% respectively. For the spraying method, adult mortalities for *M. azederach, V. album, H. arenarium* and *R. luteum* were 91%, 80.84%, 58% and 58% respectively at the same concentrations.

KEY WORDS: Plants, extract, insecticidal effect, green peach aphid

The practice of using plant derivatives, or botanical insecticides as they are now known in agriculture, dates back at least two millennia in ancient China, Egypt, Greece and India (Thacker, 2002; Ware, 1883). All over the world, the documented use of botanicals extends back more than 150 years, dramatically predating discoveries of the major classes of synthetic chemical insecticides in the mid-1930s to 1950s. However, history shows that overzealous use of synthetic insecticides led to numerous problems unforeseen at the time of their introduction: acute and chronic poisoning of applicators, farmworkers, and even consumers; destruction of fish, birds, and other wildlife; disruption of natural biological controls and pollination; extensive groundwater contamination, potentially threatening human and environmental health, and the evolution of resistance to pesticides in pest populations (Isman, 2006). In this context, many researchers are experimenting and developing alternative plant extracts as potential pesticides. Plants are the richest source of renewable natural pesticides. There are many benefits of using botanical pesticides such as reduced environmental degradation, increased safety for farm workers, increased food safety, reduction in pesticide resistance, and improved profitability of production. The majority of plant extracts contain alkaloids and terpenoids, which have been shown to affect insects' behavior, growth and development, reproduction, and survival (Arnason, 1989; Warthen, 1990). Extracts have been developed and their effects tested against insect pests of *Chrysanthemum roseum* Web. and Mohr. (Compositae), *Nicotiana tabaccum* L. (Solanaceae), *Derris elliptica* Benth (Fabaceae), neem tree, *Azadirachta indica* A. Juss (Meliaceae), and *M. azaderach*.

Researchers have shown that extract of *M. azedarach* is effective as a strong antifeeding agent and caused mortality on some species of insects (Brauer & Devkota, 1990; Oroumci & Lorra, 1993; Yelekci et al., 1981; Erdogan & Toros, 2005).

H. arenarium is a member of Asteraceae family. Also known as medicinal plant. It has been used in folk herb medicine for treatments of various conditions including for gallbladder disorders because of their bile regulatory and diuretic properties (Eroglu et al., 2010). The extract obtained from *H. arenarium* showed acaricidal effect on *T. urticae* and decreased fecundity (Erdogan et al., 2012).

R. luteum is a species of *Rhododendron* native to southeastern Europe and southwest Asia. It was determined that an extract of *R. luteum* showed acaricidal effect on *T. urticae* and decreased fecundity (Erdogan et al., 2012).

The root of *V. album* is very poisonous with a paralyzing effect on the nervous system. In two cases of fatal poisoning from eating the seeds, the toxins veratridine and cevadine were present in the blood (Fough et al., 1983). According to literature, it was determined that the extract of *Veratrum* contains a particularly toxic group of steroidal alkaloids (Bergmann, 1958).The extract of *V. album* has been used as a source of insecticides and fungicides since the era of the Romans (Gomilevsky, 2010). Researchers revealed that the extract of *V. album* extended the life of the larvae of *Musca domestica* (Diptera: Muscidae) (Ernst, 1958). Similarly, Aydin et al. (2014) found that the extract from dried rhizomes of *V. album* was toxic against *Leptinotarsa decemlineata* Say (Coleoptera: Chrysomelidae).

M. persicae is a pest of worldwide importance and causes crop losses directly by feeding and indirectly by virus transmission. Damage from aphids can be direct or indirect. Direct damage to plants occurs from the feeding activity of aphid nymphs and adults. Indirect damage can be caused by deposits of honeydew. This is the sugary, sticky liquid produced by aphids as a result of feeding on plant fluid. Crops must be sprayed with synthetic insecticides to control aphid populations. Aphids transmit many plant diseases (Petitt & Smilowitz, 1982). It is difficult to control aphid populations because they are resistant to many synthetic insecticides. The other problem with synthetic insecticides is environmental pollution and effect on non-target organisms (Barbercheck, 2011).

The aim of the current study was to investigate the efficacy of four plant extracts.

The research was undertaken under laboratory conditions at the Central Plant Protection Research Institute in Ankara in 2011.

MATERIALS AND METHODS

Insect culture

M. persicae were reared in the laboratory at 25±1◦C under long daylight (18 h: light: 6 h dark) and 65-70% relative humidity on potted radish. The radish plants used in the experimental work were grown in both a greenhouse and in the field.

Plants and Preparation of Extracts

The plants of *R. luteum, H. arenarium, V. album* used in their research were collected during 2011 in Ankara, Adana, Rize and Ordu provinces. Plant material was collected during the flowering stage at the three plants. Flowering plants were cut at soil level and whole plant was used for extraction. Only fruits of *M. azedarach* were used to obtain extract. Fruits of *M. azedarach* were collected during harvest. Harvested plants and fruits were allowed to dry in laboratory

conditions. Once the plant material was grounded using a small grinder. For extraction, 200 g of each powdered materials and 400 ml of ethanol (80%) were added to the dried powder for 72 hours. The above mixture placed into Soxhlet for 5-6 hrs. to obtain the useable extract as insecticide. After filtering through a Bucher funnel and Whatman No.1 filter paper, the extracts were concentrated under low pressure using rotary evaporator (50–60◦C). Crude extracts were reconstituted to have the concentration of 20% (w/v) using ethanol 80% (v/v in distillated water) and stored at 4ºC in glass vials to be used as stock plant extracts. For the tests, these stock plant extracts were dissolved in distilled water containing TritonX.100 at a rate of 0.1ml/l.

Plant Extract Efficacy on M. persicae

Leaf-dipping method; from untreated radish leaves, 3 cm in diameter discs were punched out. These discs were then dipped into the plant extract test solutions (1%, 3%, 6%, and 12 %) for 60 s. The control discs were dipped in 0.01% Triton X-100 solution. Then they were left to dry for 30 minutes. The treated leaf discs were placed into petri dishes lined with moistened filter paper. Then 10 apterous adults and 10 nymphs of *M. persicae* were introduced onto the treated discs in separate petri dishes. Same procedure was used for control.

Spraying method; radish leaf discs were placed into Petri dishes on moisturized filter paper as described previously. Then 10 apterous adult *M. persicae* were transferred onto the disc and, leaf discs were sprayed with different concentration of plant extracts (1%, 3%, 6%, 12%) using a hand held sprayer; control (untreated) discs were sprayed with (0.01% Triton X-100). After spraying was completed, discs were left to dry for 15 minutes. Once adults were dried, the treated *M. persicae* were transferred to untreated leaf discs (Bollhalder & Zuber, 1996).

The experiment was replicated 10 times including control. For each petri dish, 10 adult and 10 3 day old nymphs were used. Data collection started after 1, 3, and 6 days by counting the number of living nymph and adults. The experiments were conducted in a controlled climate chamber maintained at 25±1◦C and under long daylight (18:6 h light: dark). The effect was calculated according to Abbott (1925). Results were submitted to analysis of variance and the mean values were compared using Duncan's (1955) test (P = 0.05) using the statistical program SPSS 20.6.

RESULTS

Effect of the Extracts on Nymphal Stage

For the leaf-dipping method, the effects of different ethanolic extracts of *M. azaderach, V. album*, *H. arenarium* and *R. luteum* on nymphs of *M. persicae* are given in Table 1.

As shown in Table 1, it can be observed that for the nymphs treated with the four different plant ethanol extracts, the highest mortality rate was obtained at a concentration of 12% for *M. azedarach* and *V. album*. The extracts obtained from *H. arenarium* and *R. luteum* showed lower mortality rates than other extracts. Statistical analysis (at P<0.05) indicated statistical differences between the treatments. It was determined that the extract of *M. azedarach* and *V. album* had the highest effect on the nymphal stage of *M. persicae*. The lowest effect was for the extracts of *H. arenarium* and *R. luteum* (F=9.138, P=0.00).

Effect of the Extracts on Adults Stage

Leaf-dipping method; different concentrations of extracts of *M. azaderach, V. album, H. arenarium* and *R. luteum* were tested to evaluate their insecticidal

effect against *M. persicae* adults. Results are given in Table 1. According to this, the lowest mortality for all four plant extracts was found at concentration 1%. The extract obtained from *M. azaderach* had the highest mortality rate at 12% concentration. These values were followed by extracts of *H. arenarium* and *R. luteum* respectively. Mortality rate increased with increasing concentrations (F=22.707, P=000).

Spraying method; adults treated with 12% concentration of four extracts showed the highest mortality and the lowest effect was found at 1%. It can be seen from Table 1 that the extracts of *M. azaderach, V. album, H. arenarium* and *R. luteum* at 12% concentration gave 91%, 83%, 58%and 58% mortality respectively. These results are significantly different from control (F=11.264, P=0.00).

According to the analysis, ethanolic extracts of *M. azaderach* and *V. album* caused the maximum insecticidal activity, followed by *H. arenarium* and *R. luteum*. The extracts obtained from *M. azaderach* and *V. album* each at the 12% concentration caused significant increase in mortality rate (F=12.345, P=0.00) (Table 1).

DISCUSSION

Previous researchers indicated that extracts of some plant species had insecticidal effect on *M. persicae*. For example, the extracts of *Achillea wilhelmsii* C. (Asteraceae), *Hyoscyamus niger* L. (Solanaceae), *M. azedrach*, *Azadirachta indica A. Juss.*(Meliaceae), *Allium sativum* L. (Amaryllidaceae), *Capsicum annum L.* (Solanaceae), *Menta pierita* L. (Lamiaceae) and *Tanacetum vulgare* (Asteraceae) showed large effect on *M. persicae* (Dancewicz & Gabrys, 2008; Ikeura et al., 2012; Erdogan & Yildirim, 2013).

The most important finding of our study is the demonstrated toxicity of the extracts from four species on *M. persicae*. Comparing total mortality percentages of *M. azedarach* and *V. album* ethanolic extracts gave good insight about their bioactivity. The extracts obtained from *M. azaderach* and *V. album* caused high mortality. The significant decrease in the number of pests on the treated disc indicates the effectiveness of the two plant extracts. The reduction in pests' numbers was due to the insecticidal properties of *M. azaderach* which caused mortality. It is determined that *A. indica* has got such as triterpernoids, azadirachtin and salanin which caused antifeeding, deterrent of eggs, repellent and insecticidal on insects (Schmutterer et al., 1981; Schmutterer & Asher, 1984). Of interest, *M. azaderach* is the same family *A. indica* and include the same active ingredients which effect on insects (Oelrichs et al., 1983). Earlier, Capinera (2008) reported that extract obtained from *M. azedarach* was most effective at 25%, 12.5% and 1.25% concentration causing 100% mortality of *M. persicae*, *Aphis gossypii* and *Aphis fabae* respectively, and showed repellent effects on all species. Recently, there have been many research projects on the effect of azadirachtin obtained from neem tree on *M. persicae*. Griffiths et al., (2009) found that adults and nymphs fed treated neem tree seed extract showed strong repellency and individuals could not build a colony. Different Neem formulations, Azadirachtin % (AZ-A, 51% vegetable oil), caused high mortality rate 12 days after treatment, and had no systemic effect on *A. fabae* (Schulz et al., 1996). Moreover, commercially available neem-based formulation, Neem Azal T/S, caused high mortality in nymph and adults of *M. persicae* (Bollhalder & Zuber, 1996).

In our study showed that the extract of *V. album* caused high mortality in nymph and adults of *M. persicae*. There were no references in the literature of other studies using ethanolic extracts of *V. album*. There are other references

which report insecticidal effects of *V. album* on different insect species. For example, according to Bergmann (1958) the extract of *Veratrum* contains a particularly toxic group of steroidal alkaloids. In addition, Fough et al. (1983) found *V. album* extract consisted of the toxins, veratridine and cevadine. It was thought that these toxic substances from *V. album* caused insecticidal effects on *M. pesicae*. There are some references of insecticidal effects of *V. album* extracts on different insects. For example, Aydin et al. (2014) found that the dried rhizomes of *V. album* was toxic against *Leptinotarsa decemlineata* Say (Coleoptera: Chrysomelidae).

The extracts of *H. arenarium* and *R. luteum* showed less effect than the extracts of *M. azaderach* and *V. album*. There were no references in the literature of other studies using ethanolic extracts of *H. arenarium* and *R. luteum* plants against *M. persicae*. There are other references which report insecticidal effects of other plant extracts on *M. persicae*. For example, extract of *T. vulgare* showed repellent effect on ***M.*** *persicae* and adults could not develop a colony (Dancewicz & Gabrys, 2008). Furthermore, Pavela (2009) reported that the extracts derived from *Chrysanthemum cinerariifolium* had a mortality rate of 100% against *M. persicae* after 12 days of treatment. Similarly, Zhou et al., (2005) revealed that the extract of *Xanthium sibiricum* L. caused 87% mortality on *M. persicae*. Extracts of *Pittosporium tobira* and *Camellia japonica* caused the highest mortality against *M. persicae*, and extracts obtained from *Fatsia japonica*, *Dendropanax morbifera* and *Ficus carica* prevented reproduction of *A. gossypii* after 24 h. treatment (Kim et al., 2005). Other insect pests were also found to be inhibited by plant extracts. According to the results of Lee et al., (2001) the extracts of *Nelumbo nucifera* and *Ulva lactuca* caused mortality of 90% in *M. persicae*. Moreover, several herbal extract derived from *Geranium macrorrhizum* L., *Euphorbia cyparssias* L. and *Silybum marianum* L. caused 100 % mortality against nymphal and adult stages of *M. persicae* (Velcheva et al., 2001). Griffiths (2009) found that adults and nymphs fed treated neem tree seed extract suffered strong repellent effect and individuals could not build a colony. In addition, Lai & You (2010) revealed that extract derived from *A. sativum* showed high toxicity against *M. persicae* under both laboratory and field conditions, as well as repellent effects. Zhou & Liang (2003) revealed that the extracts of *Tephrosia vogelli* and *Cinnamomum campora* L. caused high rates of mortality in *M. persicae, A. gosyypii* and *Lipaphis erysimi*.

This study has contributed to the assessment of using medicinal plants as potential insecticides (Pavela, 2007). The extracts were evaluated for their effect on *M. persicae,* an important pest of many plants (Petitt & Smilowitz, 1982). The results of this study indicated that the ethanolic extracts of *M. azaderach* and *V. album* can be useful to control *M. persicae* populations on vegetable plants grown in IPM and organic systems of agriculture.

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Table 1. The effect of extracts obtained from different four plants on *Mysuz persicae* nymphs and adults (Mean±St.Error)*

Treatment		Leaf-dipping method				Leaf-spraying method	
		Nymph		Adult		Adult	
	Co.(%)	Mortality (%)	Effect (%)	Mortality (%)	Effect (%)	Mortality (%)	Effect (%)
M. azedarach	1	51.00±3.42c	46.44±3.43c	50.00±2.98d	40.70±4.17c	59.00±2.33c	40.69±4.17c
	3	63.00±3.42c	54.30±3.17c	71.00±2.77c	67.09±3.74b	63.00±3.00c	66.80±3.65b
	6	77.00±1.33b	71.21±2.00b	83.00±2.13b	81.16±2.72a	78.00±2.91b	80.05±3.5b
	12	94.00±2.13a	92.78±2.71a	91.00±1.80a	89.22±2.22a	91.00±2.00a	89.35±2.21a
H. arenarium	1	32.00±1.33c	28.05±2.21c	32.00±2.00c	22.22±1.93c	32.00±2.00c	19.27±2.77c
	3	35.00±1.53c	37.36±2.92b	36.00±1.63c	23.33±2.23c	35.00±1.67c	23.05±3.11c
	6	51.00±2.33b	48.19±1.76a	43.00±2.13b	32.50±3.37b	45.00±2.24b	34.99±3.04b
	12	65.00±1.67a	58.61±2.28a	57.00±2.98a	50.28±2.82a	58.00±2.00b	50.27±2.81a
R. luteum	1	39.00±1.80c	28.05±2.21c	31.00±1.80c	18.75±1.83c	35.00±4.28c	21.72±2.78c
	3	47.00±2.13b	37.36±2.92b	35.00±1.67bc	23.33±2.23b	41.00±1.67c	27.05±3.11c
	6	52.00±2.49b	48.19±1.76a	43.00±2.13b	32.50±3.37b	44.00±1.63b	35.00±3.04b
	12	61.00±3.79a	58.61±2.28a	61.00±3.64a	49.17±4.50a	58.00±2.00a	50.28±2.82a
V. album	1	32.96±3.65c	32.96±3.65c	40.00±2.87c	32.40±3.90c	41.00±3.45c	31.30±3.90d
	3	43.39±3.43c	41.39±3.43c	55.00±2.34c	46.81±5.47b	64.00±2.67b	56.80±5.47c
	6	69.00±3.03b	65.00±3.03b	71.00±3.45b	67.89±3.33a	73.00±3.02b	68.40±2.37b
	12	80.16±2.42a	80.16±2.42a	87.00±1.67a	85.71±2.44a	83.00±1.93a	80.84±3.44a
	Control	15.00±2.33d		14.00±1.67d		14.00±1.67d	

*Within columns, means ± SE followed by the same letter are not significantly different (DUNCAN's multiple *F*-test.
Co.: Concentrations