J. Entomol. Res. Soc., 18(1): 27-35, 2016 *ISSN:1302-0250*

Insecticidal Activity of Three Different Plant Extracts on the Green Peach Aphid [(*Myzus persicae* Sulzer) (Hemiptera: Aphididae)]

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ABSTRACT

Green peach aphid [(*Myzus persicae* Sulzer) (Hem.: Aphididae)] is a very important pest worldwide, causing serious damage to vegetables, flowers and fruit crops and is a vector for virus. The efficacy of insecticides extracted from three different plants such as *Xanthium strumarium* L. (Asteraceae), *Tanacetum parthenium* L. (Asteraceae) and *Hypericum calycinum* L. (Hypericaceae) was tested as alternative insecticides. The insecticidal activity of three plants' ethanol extracts were tested on *M. persicae*. For bioassays two different methods were used with different concentrations. Experiments were conducted using 3 cm diameter leaf disk from untreated radish [*Raphanus sativus* L. (Brassicaceae)]. All experiments were replicated 10 times. The experimental results *X. strumarium, T. parthenium* and *H. calycinum* extracts showed nymphal mortality of 89%, 88% and 57% respectively at the highest (12%) concentration. The mortality of adults at the same concentration of 12% was 82%, 88% and 57% respectively. For the spraying method, mortality of adults at the same concentration of 12% was 84%, 87% and 60% respectively.

Key words: Green peach aphid, *Hypericum calycinum, Tanacetum parthenium*, *Xanthium strumarium*, extract, insecticidal effect.

INTRODUCTION

M. persicae is a pest of worldwide importance and causes crop losses by both feeding and virus transmission and infection. Crops must be sprayed with synthetic insecticides to control aphid populations. Aphids transmit many plant diseases (Petitt and Smilowitz, 1982). It is diffucult to control aphid populations, because they are resistant to many synthetic insecticides. The other problems with synthetic insecticides are environmental pollution and effect on non target organizms (Georghiou, 1987; Ditrich, 1962). Many researchers are experimenting and developing alternative plant extracts as pesticides to be used against insects pest. Plants have 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 are alkaloids and terpenoids which have now been known to affect insects' behaviour, growth and development, reproduction,

and survival (Arnason *et al.*, 1989; Warthen *et al.*, 1990). Commercial plant extracts from *Chrysanthemum roseum* Web. and Mohr. (Compositae), *Nicotiana tabaccum* L. (Solanaceae), *Derris elliptica* Benth (Fabaceae), neem tree, *Azadirachta indica* A. Juss (Meliaceae), *Melia azaderach* L. (Meliaceae) have been developed and they have been used against different insect pests (Schmutterer *et al*., 1981; Schmutterer and Asher, 1984; Deeboun *et al.*, 2014).

X. strumarium contains significant concentrations of the extremely toxic chemical carboxyatratyloside (Kamboj and Saluja, 2010). Researchers have shown that *X. strumarium* is effective as an insecticide, acaricides, and has repellent and antifeeding properties (Malik *et al*.,1987; Nandal and Bhatti, 1986; Harada *et al*., 1985; Cetinsoy *et al*., 1998; Sarmah *et al.*, 2009; Erdogan and Toros, 2007; Erdogan *et al*., 2009).

T. parthenium is used as medicinal plant against treatment of migraine (Martindale, 1999). Other researchers have shown that feverfew is effective as an anti-inflammatory and antinociceptive agent (Heptinstall *et al.,* 1985; Murphy *et al.,* 1988; Sumner *et al.,* 1992; Jain and Kulkarni, 1999; Williams *et al.,* 1999). Another Asteracae extract of *T. vulgare* inhibited the development of *Dermanyssus gallinae* (Mesostigmata: Dermanyssidae) (Maurer *et al*., 2009). In addition, it is determined that an extract of *T. vulgare* affected also *Sacoptes scabiei var suis.* and *T. urticae* (Magi *et al.,* 2006; Chiossan *et al.,* 2001; Tiuman *et al*., 2005; Pavela *et al*., 2010). There is no references of insecticidal effect of *T. parthenium* exctract on *M. persicae.* The extract from *T. parthenium* was first time used against *M. persicae*.

Extract of *H. calycinum* have been reported to exhibit acaricidal activity against *Tetranychus urticae* Koch. (Acarina:Tetranychidae) (Erdogan *et al.,* 2012).

The aim of this study was to evaluate the effect of *H. calycinum, T. parthenium* and *X. strumarium* extracts on M. persicae.

MATERIAL AND METHODS

Insect culture

M. persicae was reared on radish plant within climate conditions in which 25±1ºC temperature, 65±5% relative humidity and 16:8 photoperiod conditions were met. The radish plants used in the experiments were grown in a greenhouse and in the field.

Plants and preparation of extracts

The plants used in this research were collected during 2010 in middle Anatolia around Ankara and Çankırı provinces. *H. calycinum and T. parthenium* were collected during the floworing. Flowering plants were cut at soil level and the whole plant was used for extraction. Also, *X. strumarium* was collected its fruit. Harwested plants and fruits were allowed to dry in laboratory conditions. Plant and fruit materials were ground using a small grinder. For extraction, 200 g of each powdered plant materials and 400 ml of ethanol (80%) were added to the dried powder for 72 hours. The above mixture was placed into a Soxhlet for 5-6 hrs to obtain the usable 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 (50-60ºC). Crude extracts were reconstituted to have the concentration of 20% (w/v) using ethanol 80% (v/v in distilled 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 *Myzus persicae*

Leaf-dipping method

From untreated radish leaves 3 cm in diameter discs were punched out. These discs were then dipped into the test solutions (1, 3, 6, and 12%) for 60 seconds.The control discs were dipped in 0.01% Triton X-100 solution, then left to dry for 30 minutes. The treated leaf discs were placed into petri dishes lined with moistened ftilter paper. Then 10 adult and 10 nymphs of *M. persicae* were introduced onto the treated discs in seperate petri dishes. Same procedure was used for control (Bollhalder and Zuber, 1996).

Spraying method

Radish leaf discs were placed into Petri dishes on moisturized filter paper. Then 10 adult *M. persicae* were transfered onto the discs and using a hand held sprayer, leaf discs were sprayed with different concentrations (1, 3, 6, 12%) control (untreated) discs were sprayed with 0.01% Triton X-100. After the spraying was completed, discs were left to dry for 15 minutes. Once discs were dried, the treated *M. persicae* were transferred to untreated leaf discs (Bollhalder and Zuber, 1996).

The experiment was replicated 10 times including control. For each petri disc containing 10 adults, 3 day old nymphal stage was used. Data collection started after 1, 3, and 6 days by counting the number of living nymphs and adults. The experiments were conducted in a climate chamber under controlled conditions (25±1ºC, 60±5% r.h. and 16:8 h; L: D). Effect was calculated according to Abbott (1925). The obtained results were submitted to a variance analysis and the mean values were compared by Duncan (1955)'s test (P = 0.05) calculated by the program SPSS 20.6. Mortality rate was calculated as mortality = after treatment the number of died aphids/before treatment the number of aphid.100).

RESULTS

Plant extracts efficacy on *Myzus persicae*

Leaf dipping methods

The effects of different ethanolic extracts of *T. parthenium*, *X. strumarium* and *H. calycinum* plants on *M. persicae* nymphs are given in Table 1.

As shown in Table 1, for nymphs treated with three different plant extracts, the highest effect was obtained at a concentration of 12% of *T. parthenium*. Of the three

plant extracts, *T. parthenium* showed the highest mortality rate. On the other hand, the lowest mortality rate was found for *H. calycinum.* Statistical analysis showed (P<0.05) significance among treatments. The extracts of *T. parthenium* and *X. strumarium* showed the highest effect on the nymphal stage of *M. persicae*. The lowest effect was for *H. calycinum.* The lowest mortality rate was found for control. These results are significantly different when compared statistically with control.

Table 1. Efficacy and mortality of extracts obtained from different three plants on *Myzus persicae* Sulzer (Hemiptera: Aphididae).

Treatment	Leaf dipping method					Spraying method	
	Nymph			Adult		Adult	
	Conc. (%)	Mortality (%)	Efficacy (%)	Mortality (%)	Efficacy (%)	Mortality (%)	Efficacy (%)
X. strumarium	1	45	34.58±4.66d*	38	24.30±3.43d	36	24.30±3.43c
	3	61	54.17±4.44c	54	56.53±2.22c	63	56.52±2.22b
	6	75	70.45±2.16b	73	77.52±2.96b	81	77.52±2.95a
	12	89	85.67±3.10a	82	81.00±3.24a	84	81.00±3.23a
T. parthenium	1	59	51.28±5.38d	48	23.47±1.61d	35	23.47±1.60c
	3	70	64.86±3.67c	60	58.80±1.97c	65	58.79±1.96b
	6	82	78.99±2.28b	75	64.62±2.73b	70	64.61±2.72b
	12	88	84.64±3.83a	88	84.46±2.65a	87	84.45±2.65a
H. calycinum	1	29	19.86±1.64c	27	30.55±3.07c	41	30.55±3.07b
	3	37	25.97±1.66b	35	35.28±1.58b	45	35.27±1.57b
	6	43	32.92±2.88b	40	48.38±2.77b	56	48.37±2.77a
	12	57	44.44±3.46a	57	53.06±2.04a	60	53.05±2.03a
	Control	15		14		14	

(F=46.21, P=0.00)

*Means within rows followed by the same letter are not significantly different (P<0.05, Duncan's multiple range test). Conc.: concentrations

Different concentrations of extracts of *T. parthenium*, *X. strumarium* and *H. calycinum* were tested to evaluate their insecticidal effect against *M. persicae* adults. Results are summarized in Table 1. According to this, the lowest effect all of three plant extracts was detected at concentration 1%. Extracts of *T. parthenium* and *X. strumarium* at 12% concentration exhibited pronounced 82-88% mortality whereas at the same concentration of *H. calycinum* showed 57% mortality. The mortality showed a linear trend i.e., increasing with higher concentration.

Spraying method

The adults treated with 12% concentration in three different extracts showed the highest mortality and the lowest effect was at 1% (Table 1). It can be seen from Table 1 that extracts of *T. parthenium*, *X. strumarium* and *H. calycinum* at 12% concentration

gave 87%, 84% and 60% mortality accordingly. These results are significantly different when compared statistically with control.

CONCLUSIONS AND DISCUSSION

Several plants have been found to contain bioactive compounds with a variety of biological actions against insects, including repellent, antifeedant, anti-ovipositional, toxic, chemosterilant, and growth regulatory activities (Singh and Saratchandra, 2005; Sertkaya *et al*., 2010). Therefore, botanical insecticides have long been recommended as attractive alternatives to synthetic chemical insecticides for pest management because these chemicals pose little threat to the environment or to human health (Isman, 2006).

At the end of the study, the extracts of *T. parthenium* and *X. strumarium* were shown to have both contact and systemic effect on adult and nymphal stage of *M. persicae*. Effects on adult and nymphal mortalty of *M. persicae* from extracts obtained from *T. parthenium* and *X. strumarium* were significantly higher than from extracts obtained from *H. calycinum.* Particularly, the highest mortality was found in the 12% concentrations of the three plant extracts.

Different studies have shown that extract of X. strumarium effect on different insects and mites. For example, crude extracts of X. strumarium showed contact effect on larva of L. decemlineata, and the extract of X. strumarium caused high mortality of L. decemlineata (Gokce et al., 2007). Similarly, it was revealed that depending on the rising rate of concentration of extract of X. strumarium a prolonged larvae and pupae instar, causing a high mortality rate of larvae and pupae during instar, and led healthy females to lay fewer eggs (Erdogan and Toros, 2007). In addititon, the extracts of X. strumarium were shown to have both contact and residual effect on adult of T. urticae (Yanar et al., 2011). Similarly, Zhou and Liang (2003) revealed that the extract of X. sibiricum caused 87% mortality of M. persicae. According to Islam et al., (2009) the extract of X. strumarium contains a particularly toxic group of terpenoid and xanthinin. It was thought that these toxic substances from X. strumarium caused insecticidal effects on M. pesicae.

Also, the extracts of *T. parthenium* was shown to have both contact and systemic effect on adult and nymphal stage of *M. persicae*. There are many studies on insecticidal and acaricidal activities of *T. parthenium* extracts. For example, the extract of *T. parthenium* showed high mortality, antifeedancy and growth inhibition against larvae of *S. littoralis* (Pavela *et al*., 2010). It was determined that an extract of *T. parthenium* showed acaricidal effect on *T. urticae* and caused high mortality (Erdogan *et al.,* 2012). Pavela (2009) reported that the extracts derived from *Chrysanthemum cinerariifolium* had 100% mortality rate against *M. persicae* after 12 days of treatment. *Chrysanthemum* or *Tanacetum* plants contains pyrethrum substance. The six esters known collectively as pyrethrins are found within the pyrethrum extract. The pyrethrins are the active ingredient in pyrethrum that kills insects (Martin and Woodcock, 1983). It was thought that these toxic substances from pyrethrins caused insecticidal effects

on *M. pesicae.* Morover, Pavela (2009) reported that the extracts derived from *A. indica*, *Chrysanthemum cinerariifolium* and *Pangomia glabra* had 100% mortalty rate against *M. persicae*, and the extract of *P. glabra* showed the highest mortalty rate after 12 days of treatment. In addition, extract of *T. vulgare* showed repellent effect on *M. persicae* and adults could not develop a colony (Dancewicz and Gabrys, 2008).

In recent years, many studies have also been conducted to investigate the activities of plant extracts and essential oil against *M. persicae*. For example, the extract obtained oil from *M. azedarach* was the most effective at 25%, 12. 5% and 1.25% concentration causing 100% mortality of *M. persicae*, *Aphis gossypii*, *Aphis fabae*, and showed repellent effect on all of species (Capinera, 2008). The extracts of *Pittosporium tobira* and *Camellia japonica* caused the highest mortalty against *M. persicae*, and extract obtained from *Fatsia japonica*, *Dendropanax morbifera* and *Ficus carica* decreased the reproductive rate by 100% against *A. gossypii* after 24 h. treatment (Kim *at al.*, 2005). Other insect pests were also found to be inhibited by plant extracts. According to the results of Lee *et al.* (2001), the extract of *Nelumbo nucifera* and *Ulva lactuca* caused mortality of 90% on *M. persicae.* Also, several herbal extract derived from *Geranium macrorrhizum* L., *Euphorbia cyparssias* L. and *Silybum marianum* L. caused 100 % mortalty against nymphal and adult stage of *M. persicae* (Velcheva *et al*., 2001). Griffiths *et al.* (2009) found that adults and nymphs fed treated neem tree seed extract were affected by strong repellent effect and individuals could not build a colony. In addition, Lai and You (2010) revealed that extract derived from *A. sativum* was highly toxic against *M. persicae* under both laboratory and field conditions, and also showed repellent effect on this species. Zhou and Liang (2003) revealed that the extract of *Tephrosia vogelli* and *Cinnamomum campora* L. caused high rates of mortality in all three species (*M. persicae, A. gosyypii* and *Lipaphis erysimi*).

It was determined that the extract of *X. strumarium* and *T. parthenium* had a high rate of mortality and insecticidal effect on *M. persicae*. The results of this study indicated that the ethanolic extracts of *X. strumarium* and *T. parthenium* can be useful in controlling *M. persicae* populations on vegetable plants grown in IPM and organic systems of agriculture.

ACKNOWLEDGEMENTS

The authors are grateful to Prof. Dr. Betül Sever to prepare plant extracts used in the study. University of Ankara, Faculty of Pharmacy, Pharmacognosy Department, Tandoğan /Ankara-TURKEY.

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Received: February 12, 2015 *Accepted: January 29, 2016*