Pestycydy/Pesticides, 2008, (3-4), 93-99.
ISSN 0208-8703

Effect of extracts of garlic (*Allium sativum* L.), wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) on the behaviour of the peach potato aphid *Myzus persicae* (Sulz.) during the settling on plants

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Abstract: Plant derived extracts and phytochemicals have long been a subject of research in an effort to develop alternatives to conventional insecticides but with reduced health and environmental impact. In the present study, the aphid settling deterrent activity of extracts obtained from garlic (*Allium sativum* L.), wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) against peach potato aphid (*Myzus persicae* [Sulz.]) was investigated. The settling of *M. persicae* on host plant leaves was strongly deterred by soap 1%, soap 4%, Bioczos Forte 2% + soap 1%, Bioczos 1% + tansy extract 1%. Their effect was observed after 1 hour aphid had got access to the plants and it lasted until the end of the experiment, i.e. 24 hours after application. After 24 hours, aphid settling was deterred by the following combinations of extracts: Bioczos 2%, Bioczos 2% + soap 1%, Bioczos 5%, Bioczos 5% + soap 1%, Bioczos 1% + wormwood extract 1%, Bioczos 1% + wormwood extract 1% + soap, tansy extract 1% + wormwood extract 1% and tansy extract 1% + wormwood extract 1% + soap 1%.

Keywords: plant extracts, *Allium sativum*, *Artemisia absinthium*, *Tanaceum vulgare*, *Myzus persicae*, deterrent activity

INTRODUCTION

The peach potato aphid *Myzus persicae* (Sulz.) is one of the most noxious species. It can infest plants of over 40 different families including many

economically important ones world wide, and it is able to transmit over 100 plant viruses [1].

At present, aphid control depends mainly on the use of insecticides. Due to the repeating applications, many aphid species, especially the peach potato aphid, have developed resistance to several chemical aphicides [2, 3]. Therefore, an alternative method of aphid control is needed. One of the possible approaches is the use of plant extracts which would repel aphids or deter their feeding, and in consequence, reduce their number on plants.

Plant extracts obtained from garlic (*Allium sativum* L.), wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) have a broad spectrum of biological activity. Their anti-inflammatory, antibacterial and antifungal activities are well known [4-11]. Extracts from these plants possess also anti-insect properties. Methanolic extracts of garlic have been reported to be larvicidal against larvae of several species of mosquitoes, cluster caterpillar *Spodoptera litura* (Fabricius), and the lymantriid *Euproctis* sp., [12]. Water extracts of tansy have antifeedant and insecticidal effect on larvae and adults of some species of Lepidoptera and Coleoptera [8, 13]. Also wormwood is famous for its antifeedant properties [4]. In addition, garlic and wormwood extracts have been reported to exhibit insecticidal activity against aphids *M. persicae* and *Brevicoryne brassicae* [14].

The aim of this study was to evaluate the effect of garlic, wormwood, and tansy extracts on the settling of *M. persicae* on plants.

MATERIAL AND METHODS

Aphid and Plants: Aphids (*M. persicae*) and plants (Chinese cabbage *Brassica pekinensis*) were reared in laboratory at 20 °C, 65% r.h., and L16:8D photoperiod. Young, 2-3 days old viviparous apterous females were selected for experiments. Cabbage plants used in the bioassays were 5-6 weeks old.

Extracts: The activity of the following extracts was evaluated:

- Bioczos (1%, 2%, 5%) and Bioczos FORTE (2%) − water extracts from garlic;
- Extract of wormwood 1% ;
- Extract of tansy 1% ;
- Potassic horticultural soap (1%, 4%).

The extracts were kindly provided by HIMAL company and were used as water solutions in combination with potassic horticultural soap (**E-1 − E-14**) (Table 1). Water was used as a control in all assays.

Table 1. Plant extracts and other substances studied for feeding deterrent activity to *Myzus persicae*

Symbol	Extracts
E-1	soap 1%
E-2	soap 4%
E-3	Bioczos 2%
E-4	Bioczos 2% + soap 1%
E-5	Bioczos 5%
E-6	Bioczos 5% + soap 1%
E-7	Bioczos FORTE 2%
E-8	Bioczos FORTE 2% + soap 1%
E-9	Bioczos 1% + wormwood extract 1%
E-10	Bioczos 1% + wormwood extract 1% + soap 1%
E-11	Bioczos 1% + tansy extract 1%
E-12	Bioczos 1% + tansy extract 1% + soap 1%
E-13	wormwood extract 1% + tansy extract 1%
E-14	wormwood extract 1% + tansy extract 1% + soap 1%

Aphid settling: A conventional settling choice test was conducted to evaluate the deterrent activities of studied extracts after Powell et al. (1997) [15]. Aphids were offered a choice between extract-treated and control leaves. Leaves cut from cabbage plants, were dipped for 10 s in the extract or control solution (water) and dried in the air for 1 h at room temperature. Two leaves (test and control) were transferred to Petri dishes. Afterwards, twenty apterous females of *M. persicae* were placed between the leaves at the centre of the Petri dish (the distances between two leaves approximately 2.0 cm). Aphids that settled on each leaf were counted at 1, 2 and 24 h intervals after the beginning of the experiment. This experiment was replicated 8 times for each treatment (total number of insects per treatment = 160). The data were analysed using one way ANOVA ($P \leq 0.05$). The relative index of deterrence was calculated from the total number of aphid counted on treated (T) and control (C) leaves at each time interval:

$$R = (C–T)/(C+T)$$

Possible values for the index therefore range between 1 (complete deterrent) and −1 (complete attractant), with a value at or close to zero indicating no effect.

RESULTS AND DISCUSSION

Aphids settle on plant only when they accept it as a food source [16]. Therefore, the number of aphids that settle and feed on a leaf treated with a given extract is a good indicator of its suitability.

The choice-leaf assay showed that all studied extracts with the exception of **E-7** had a deterrent effect on aphid settling. However, the deterrent activity was manifested with a varied intensity. The extracts **E-1**, **E-2**, **E-8**, and **E-11** strongly inhibited aphid settling during the entire time of the experiment. Their activity was highly significant as indicated by the P values of the statistical analysis. The deterrent properties of extracts **E-3, E-4**, **E-5**, **E-6**, **E-9**, **E-10**, **E-12**, and **E-13** were found after 24 hours of the experiment. Of these extracts, the most active was **E-5** and **E-12** (Table 2). The values of coefficient R ranged from 0.25 to 0.52 for the aforementioned extracts (Figure 1).

Table 2. Deterrent activity of garlic (*Allium sativum* L.), wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) extracts against *Myzus persicae*

Extracts		Time after access to the plants		
		1 hour	2 hours	24 hours
E-1	test	5.0 (±0.6)	5.5 (±0.7)	6.3 (±0.6)
	control	9.9 (±1.1)	10.1 (±1.1)	10.5 (±0.9)
	P	0.0014	0.0031	0.0013
E-2	test	4.8 (±0.4)	4.8 (±0.5)	6.6 (±0.9)
	control	9.6 (±0.7)	10.8 (±0.9)	10.6 (±0.9)
	P	0.0000	0.0000	0.0056
E-3	test	5.8 (±1.3)	6.1 (±1.4)	6.6 (±0.9)
	control	8.9 (±1.0)	10.6 (±1.2)	12.9 (±0.8)
	P	0.0825	0.0323	0.0002
E-4	test	6.9 (±1.5)	7.0 (±1.6)	4.8 (±1.7)
	control	10.5 (±1.7)	11.1 (±1.7)	14.1 (±1.8)
	P	0.1414	0.1059	0.0020
E-5	test	7.6 (±1.3)	7.6 (±1.3)	4.4 (±0.7)
	control	9.4 (±1.4)	10.5 (±1.4)	14.0 (±1.1)
	P	0.3789	0.1522	0.0000
E-6	test	4.4 (±0.6)	6.5 (±1.4)	5.1 (±0.8)
	control	9.0 (±1.3)	10.8 (±1.5)	12.8 (±1.3)
	P	0.0073	0.0609	0.0002

E-7	test	8.8 (±1.0)	9.5 (±1.2)	9.3 (±1.0)
	control	6.4 (±1.3)	6.6 (±1.1)	9.3 (±1.0)
	P	0.1461	0.1027	1.0000
E-8	test	3.9 (±0.8)	5.1 (±1.3)	5.4 (±1.2)
	control	9.6 (±1.1)	11.4 (±1.0)	12.3 (±1.5)
	P	0.0011	0.0020	0.0031
E-9	test	7.4 (±0.7)	7.6 (±0.7)	6.3 (±1.0)
	control	6.3 (±0.6)	7.6 (±0.7)	10.6 (±1.0)
	P	0.2598	1.0000	0.0068
E-10	test	8.4 (±1.2)	7.3 (±0.8)	4.8 (±1.4)
	control	7.6 (±1.3)	9.1 (±1.3)	10.4 (±1.5)
	P	0.6802	0.2428	0.0181
E-11	test	5.5 (±0.9)	5.6 (±0.9)	6.5 (±1.0)
	control	9.9 (±1.3)	9.0 (±1.0)	11.0 (±1.4)
	P	0.0166	0.0207	0.0211
E-12	test	7.9 (±1.0)	8.5 (±1.1)	4.6 (±0.7)
	control	7.9 (±1.0)	8.9 (±1.1)	14.5 (±0.8)
	P	1.0000	0.8112	0.0000
E-13	test	5.1 (±0.7)	6.5 (±0.9)	6.1 (±1.1)
	control	7.6 (±1.3)	9.0 (±1.4)	12.0 (±1.3)
	P	0.1080	0.1439	0.0036
E-14	test	6.8 (±1.0)	6.9 (±1.0)	5.1 (±1.9)
	control	8.6 (±0.6)	8.9 (±0.7)	12.9 (±1.9)
	P	0.1237	0.1365	0.0126

Numbers for "test" and "control" represent mean number of aphids settled on test or control leaves (± standard error) − choice test. P − significance level (ANOVA) − significant differences between number of aphids settled on either leaf are underlined.

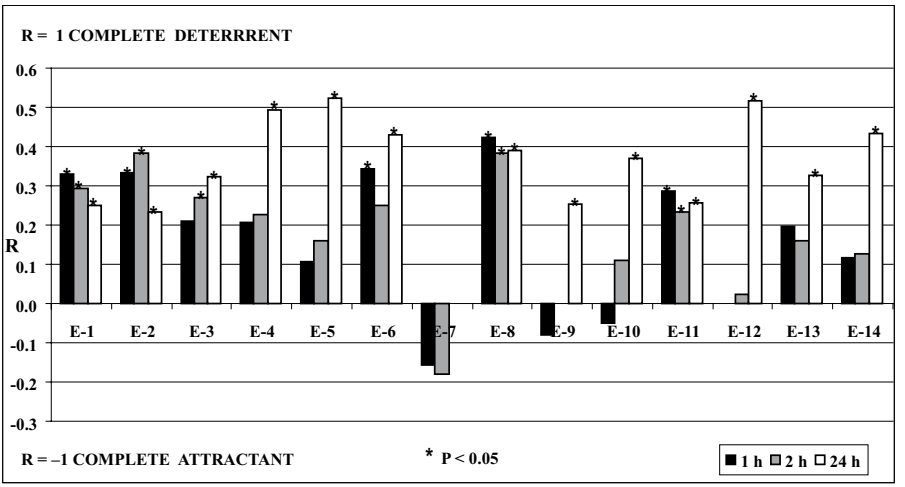

Figure 1. Effect of garlic (*Allium sativum* L.). wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) extracts (E1-E14) on settling of the peach potato aphid *M. persicae* expressed as the Relative Index of Deterrence.

In summary, it can be assumed that water extracts from garlic, wormwood, and tansy have an advantageous effect on the plants in protecting them against peach potato aphid. According to the results of the present study, these extracts may cause the reduction in the number of aphids that settle on plants.

Insecticidal properties of water, alcohol, and acetone extracts of garlic and wormwood to aphids have been reported by Achremowicz and Cież (1988) [14]. The essential oils of *A. absinthium* L. were found to be toxic to adults of granary weevil *Sitophilus granarius* (L.) (Coleoptera). The oils showed about 80-90% mortality of these insects after 48 h of exposure [17]. Repellency of garlic extract to European starlings (*Sturnus vulgaris*) was demonstrated by Mason and Linz (1997) [18]. Antifeedant properties of tansy extract have been reported by earlier studies. Nottingham and Hardie (1993) [19] found that *Aphis fabae* Scopoli was repelled by tansy odour [19]. Larocque et al. (1999) [13] indicated that tansy essential oil deterred oviposition of oblique-banded leafroller *Choristoneura rosaceana* (Harris) (Coleoptera) females.

The present study may certainly be a step towards practical application of the studied extracts in the control of *M. persicae*. However, a more reasonable use of these extracts would be as a part of a 'push-pull' strategy, in addition to other means of population reduction such as a use of pathogens or highly-selective pesticides [20].

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