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Full Length Research Paper

Effect of natural and chemical insecticides on *Hyalopterus pruni* and *Armeniaca vulgaris*

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Experiments were carried out to evaluate the effect of water extracts of *Fagonia arabica, Salix alba* and *Anthmis pseudocotula* and their mixtures with chemical insecticide (Malathion) on growth of *Hyalopterus pruni* and characters of *Armeniaca vulgaris* plants and their soils. The data revealed that *F. arabica* extract at 20% concentration was the most effective followed by *S. alba* which recorded 62.66 and 56.16% reduction in *H. pruni* population density, respectively. While the mixture of Malathion with *F. arabica* or S. *alba* or *A. pseudocotula* extracts (each one at half concentration) results in 57.88, 57.42 and 60.86% reduction in aphid population, respectively. The plant extracts treatment resulted in significant increase in chlorophyll pigments and total carbohydrates in *A. vulgaris* whereas carotenoids and total protein content decreased (except *S. alba* extract treatment which increased total protein content). Soil cations; Ca^{++}, Na^{+}, Mg^{++}, K^{+} and anions; SO_4^{2-}, HCO_3^{-}, Cl^{-} increased with all plant extracts treatment with exception of *A. pseudocotula* extract treatment that decreased HCO_3^{-} concentrations. This study recommended that natural insecticides were more effective and safe than chemical ones in pest control.

Key words: Natural insecticides, chemical insecticides, treatments, side-effect, ecosystem.

INTRODUCTION

Fruits are considered strategic crops and have obtained special attention all over the world. Aphids are considered the main pests which threaten the quantity and quality of the yield of these crops. The recent widespread application of pesticides for controlling the pests has a serious effect on the natural balance of the ecosystem. Several investigators in different parts of the world have initiated large-scale screening efforts to find plants which have interesting physiological effects on pests (Ghamry 1986, Venkaietan et al., 1987 and Bandara et al., 1990). Previous studies have not recorded the use of natural extracts of *Fagonia arabica, Salix alba* and *Anthmis pseudocotula* and their mixtures with chemical insecticide (Malathion).

Therefore our investigations were carried out to evaluate these plant extracts to minimize the growth of *Hyalopterus pruni* populations on apricot trees (*Armeniaca vulgaris*) and their effects on the tree and their supporting soils.

MATERIALS AND METHODS

Preparation of extracts

The plants *F. arabica, S. alba* and *A. pseudocotula* were immersed in warm water for 48 h and filtered to get the plant extract for each plant.

Preparation of concentrations

Crude solution of plant extracts used at rate of 750 ml from each plant extract was diluted with 3 liter water to reach 20% final concentration. The recommended concentration of Malathion (57% EC) is 250 ml/100 liter water. Each plant extract-Malathion mixture was prepared by using the half of the preceding rates.

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Application against *H. pruni* on apricot trees

To study the initial and residual toxicity of the tested plant extracts against *H. pruni* individuals, the experimental area with 24 apricot trees, were divided into 8 treatments; each one included three trees (3 replicates for each treatment). Spraying was carried out by using a knapsack motor sprayer. Samples from each treatment were collected randomly by taking 20 leaf/tree from three canopy positions (upper, middle, lower) of the tree in plastic bags just before the insecticidal application. This include pretreatment samples and treatment collection after 2, 3, 5, 7, and 9 days post treatment. The samples were examined directly by the aid of stereoscope microscope in the laboratory, where the individuals of *H pruni* were counted pre- and post-treatment. The reduction percentages of aphid population were calculated according to Handerson and Tilton (1955) formula.

Soil analysis

The soil profiles supporting apricot trees were sampled and collected in plastic bags for chemical analysis. The soil samples were taken at depth 20 cm after one week of application; the samples were air dried, sieved through 2 mm meshes and analysis was carried out. Seven hundreds ml of distilled water were added to 140 g of air-dried soil and were shaken for two hours. The heavier particles were allowed to settle and the supernatant liquid was decanted into Pastur Chamber land filter. After repeated filtration, clear soil solution was obtained then determination of anions and cations were carried out according to Jackson (1967).

Pigment analysis

The photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoids) were determined spectrophotometrically according to Metzner et al. (1965). A known fresh weight of leaves was homogenized in 85% aqueous acetone for 5 min. The homogenate was centrifuged and the supernatant was made up to known volume with 85% acetone and measured against a blank of pure 85% aqueous acetone at 3 wavelengths of 452.5, 644 and 663 nm. Taking into consideration the dilution made, it was possible to determine the concentrations of the pigment fractions (chlorophyll a, chlorophyll b and carotenoids) as *µg* / ml using the following equations:

Chlorophyll a = 10.3 E 663 - 0.918 E 644

Chlorophyll b = 19.7 E 644 - 3.87 E 663

Carotenoids = 4.2 E 425.5 - (0.0264 chlorophyll a + 0.426 chlorophyll b).

Estimation of carbohydrates

Dry sample (0.05 g) was hydrolyzed with 20 ml HCl (6 N) in carbohydrates tube for 6 h in boiling water bath and then filtrated using whatman 1. 20 ml NaOH (6 N) was added to the filtrate and made up to 100 ml with distilled water. Five ml from the filtrate was taken in test tube and 2 ml of 3,5 dinitrosalicylic acid was added. The mixture was shaken and heated for 10 min in boiling water bath, and immediately cooled in ice. The optical density was measured at 550 nm using spectrophotometer. The concentrations were obtained from standard curve (mg/g).

Estimation of protein

Nitrogen percentage was measured by taking 0.2 ml from the digested sample in 25 ml flask, then distilled water was added to reach half of the flask. 1 ml of Nesler's solution was then added. Reading was made at 420 nm using. Then total protein percentage determined according to the following equation:

Protein (%) = N (%) x 6.25

Statistical analysis

The data obtained were subjected to statistical analysis by ANOVA using SPSS version 11. Duncan's multiple range tests was used to determine the significant of the difference between mean values of the treatments.

RESULTS AND DISCUSSION

Effect of extracts on *H. pruni*

Data in Table 1 summarized the efficiency of the plant extracts and its mixtures with Malathion as well as Malathion alone against *H. pruni* populations. Initial reduction percentages of aphid population measured after 48 h post treatment ranged between a minimum of 27.82% for *A. pseudocotula* extract to a maximum of 39.71% for S. *alba* extract comparing with Malathion which recorded 71.82% as initial effect. The residual reduction percentages mean of aphids measured at days (3, 5, 7 and 9 post treatment) ranged between a minimum of 52.48% for *A. pseudocotula* extract to a maximum of 62.66% for *F. arabica* extract comparing with Malathion that recorded 71.78%. These results were in agreement with Ghamry (1986) who tested the efficacy of five plant extracts against aphids on citrus trees, Venkaietan et al. (1987) when investigating various plant extracts on *Aphis gossypii* (Glov.) populations and Hala (2000) who reported that aqueous extracts of some plants causing high reduction percentages of aphids population.

Cations content

Results remarked in Table 2 showed that Ca^{++}, Na^{+}, Mg^{++} and K^{+} have the highest concentrations in the soil supporting treated apricot trees with *S. alba* extract. Values of Ca^{++} concentrations in the soil ranged between 197.97 and 676.7 mg/L, Na^{+} between 170 and 280 mg/L, Mg^{++} between 63.81 and 165.68 mg/L and K^{+} between 16 and 44 mg/L. The control values were 141.41, 125, 36.81 and 14 mg/L for Ca^{++}, Na^{+}, Mg^{++} and K^{+}, respectively.

Anions content

Data listed in Table 3 showed that bicarbonates (HCO_3^{-}), sulphates (SO_4^{2-}) and chlorides (Cl^{-}) contents have the

Table 1. Effect of plant extracts and malathion and their mixtures on the number of *Hyalopterus pruni* under field conditions.

Treatments	Aphids no. before treatments	Aphids no. and their reduction percent after treatments											
		Initial effect		Residual effect								Mean residual effect	
		2-days		3-days		5-days		7-days		9-days			
		No.	R%	No.	R%	No.	R%	No.	R%	No.	R%	No.	R%
A (100%)	1575	1153	27.8	1050	32.8	898	46.8	532	67.8	642	62.6	780	52.5
A + D (1v:1v)	1480	919	38.8	820	44.1	587	62.9	530	65.9	476	70.4	603	60.9
B (100%)	1520	1026	33.5	921	38.9	363	77.7	472	70.4	602	63.6	589	62.7
B + D (1v:1v)	1615	883	46.1	836	47.8	945	45.4	505	70.2	560	68.1	711	57.9
C (100%)	1632	998	39.7	708	56.3	837	52.1	622	63.7	842	52.5	752	56.2
C + D (1v:1v)	1810	1177	35.9	1067	40.6	713	63.2	652	65.7	785	60.1	804	57.4
D (100%)	1725	493	71.8	286	83.3	446	75.9	578	68.1	752	59.9	515	71.8
Control	1400	1420	-	1389	-	1500	-	1470	-	1522	-	-	-
LSD (P≤0.05)	112	11	4.6	78	5.7	96	11.5	18	6.8	53	3.9	36	5.6

A = *Anthmis pseudocotula* extract at 20% concentration; B = *Fagonia arabica* extract at 20% concentration; C = *Salix alba* extract at 20% concentration; D = Malathion at 57% concentration; R% = Reduction percent of aphids.
Values followed the same letter are non-significant.

Table 2. Effect of some plant extracts and malathion on cations of the soil supporting apricot trees.

Treatment	Ca^{++} (mg/L)	Mg^{++} (mg/L)	Na^{++} (mg/L)	K^{+} (mg/L)
Anthmis pseudocotula extract at 20% concentration (100%)	197.9	65.7	190.9	21.9
Anthmis pseudocotula extract at 20% + Malathion at 57% (50% + 50%)	202.2	68.3	167.9	23.7
Fagonia arabica extract at 20% concentration (100%)	203.8	63.8	170.5	16.8
Fagonia arabica extract at 20% + Malathion at 57% (50% + 50%)	676.7	68.6	166.9	23.7
Salix alba extract at 20% concentration (100%)	623.9	165.9	280.8	44.6
Salix alba extract at 20% + Malathion at 57% (50% + 50%)	408.9	156.7	265.7	43.7
Malathion at 57% concentration (100%)	432.9	117.6	200.9	21.0
Control	141.7	36.8	125.5	14.7
LSD (P≤0.05)	54.8	35.8	24.8	2.6

Table 3. Effect of some plant extracts and malathion on anions of the soil supporting apricot trees.

Treatment	CO_3^{--} (mg/L)	HCO_3^{-} (mg/L)	SO_4^{2-} (mg/L)	Cl^{-} (mg/L)
Anthmis pseudocotula extract at 20% concentration (100%)	-	96.3	620.7	177.9
Anthmis pseudocotula extract at 20% + Malathion at 57% (50% + 50%)	-	87.9	666.8	168.9
Fagonia arabica extract at 20% concentration (100%)	-	80.9	630.8	198.9
Fagonia arabica extract at 20% + Malathion at 57% (50% + 50%)	-	85.9	634.9	211.0
Salix alba extract at 20% concentration (100%)	-	160.9	1380.7	330.9
Salix alba extract at 20% + Malathion at 57% (50% + 50%)	-	176.8	1324.9	333.8
Malathion at 57% concentration (100%)	-	80.7	640.8	220.8
Control	-	89.6	570.9	122.5
LSD (P≤0.05)	-	19.2	21.5	31.0

highest concentrations in the soil supporting treated apricot trees with S. *alba* extract. Maximum values of anions: HCO_3^-, SO_4^{2-} and Cl^- concentrations in the soil were 160.52, 1380 and 330.31 mg/L for *S. alba* extracts, while minimum value was 80.26, 620 and 177.1 mg/L for *F. arabica* extracts. On the other hand, controls were 89.89, 570 and 122.07 mg/L for HCO_3^-, SO_4^{2-} and Cl^- concentrations, respectively.

Table 4. Effect of some plant extracts and malathion on photosynthetic pigments of apricot leaves trees.

Treatment	Chlorophyll a			Chlorophyll b			Carotenoids		
	7-days	14-days	Mean	7-days	14-days	Mean	7-days	l4-days	Mean
A (100%)	2.64	2.56	2.60	3.49	3.66	3.57	1.23	1.27	1.25
A + D (1v:1v)	2.33	2.63	2.48	3.76	3.57	3.66	1.42	1.26	1.34
B (100%)	2.57	2.64	2.60	3.62	3.57	3.59	1.28	1.23	1.25
B + D (1v:1v)	2.67	2.27	2.47	3.74	3.43	3.58	1.23	1.32	1.28
C (100%)	2.57	2.68	2.71	3.66	3.67	3.66	1.25	1.30	1.27
C + D (1v:1v)	2.54	2.12	2.33	3.84	3.39	3.62	1.33	1.31	1.32
D (100%)	2.54	2.47	2.50	3.61	3.42	3.51	1.27	1.18	1.22
Control	2.17	2.17	2.17	3.20	3.20	3.20	1.26	1.26	1.26
LSD (P≤0.05)	**0.45**	**0.12**	**0.15**	**0.12**	**0.18**	**0.31**	**0.11**	**0.14**	**0.22**

A = *Anthmis pseudocotula* extract at 20% concentration; B = *Fagonia arabica* extract at 20% concentration;C= *Salix alba* extract at 20% concentration; D = Malathion at 57% concentration;R% = Reduction percent of aphids.
Values followed the same letter are non-significant.

Table 5. Effect of some plant extracts and malathion on mean total carbohydrates and total proteins of apricot leaves trees.

Treatment	Total carbohydrates (mg/g)	Total proteins (%)
Anthmis pseudocotula extract at 20% concentration (100%)	29.9	12.5
Anthmis pseudocotula extract at 20% concentration + Malathion at 57% (50% + 50%)	27.9	11.9
Fagonia arabica extract at 20% concentration (100%)	27.3	13.9
Fagonia arabica extract at 20% concentration + Malathion at 57% (50% + 50%)	26.9	11.5
Salix alba extract at 20% concentration (100%)	29.9	28.3
Salix alba extract at 20% concentration + Malathion at 57% (50% + 50%)	28.8	29.8
Malathion at 57% concentration (100%)	25.3	29.3
Control	27.1	26.0
LSD (P≤0.05)	**1.8**	**1.7**

Photosynthetic pigments

We can infer from the combined data of the two weeks that the variations in the content of chlorophyll a and b and carotenoids in the leaves of apricot trees as affected by plant extracts and malathion treatments (Table 4). There was no significant increase in chlorophyll a and b content at 7 and 14 day after application of all treatments. It is evident that there were remarkable decreases in the content of carotenoids in the leaves of apricot trees treated with the same materials. There was high significance between all treatments compared with control in chlorophyll a, b and carotenoids content. These results agree with El-Quesni and Radwan (1993) who found that the treatment with Topogard (terbuthylazine + terbutryn) on faba bean increased chlorophyll a, b and chlorophyll a+b content but decreased carotenoids in the leaves. Chlorophyll pigments, considered the most important chemical components that convert photoenergy to chemical energy, play an active role in photosynthesis and carotenoid pigments protect chlorophyll against photooxidation and transfer of energy to chlorophyll.

Total carbohydrates and proteins

It is evident in Table 5 that there were significant increases in the mean total carbohydrates in the treated leaves of apricot trees with plant extracts; 29, 27.33 and 29% for *F. arabica, A. pseudocofula* and S. *alba* extract, respectively. The control has 27% carbohydrates but in case of Malathion the percentage decreased to 25.33%. It was also clear that there was no significant increase in percentage of total protein in S. *alba* extract and Malathion treated palnts when compared to control, while there was significant decrease of total proteins in *F. arabica* and *A. pseudocotula* extracts treated plants (Table 5). In harmony with the above results, Woda (1994) reported that spraying potato plants with metribuzin reduced reducing sugars, non reducing sugars and starch in leaves of potato and influenced on protein metabolism. Carbohydrates and proteins are organic

compounds used in tissue synthesis and organs synthesis.

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