

Species composition and population of aphids in main fruit agrocenoses of the Armenia and the methods of the pest control against them

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Abstract

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Aphids (*Homoptera: Aphidoidea*), are rather a numerous group of pests of apple and pear plants in the Lori region of the Republic of Armenia. Some of the aphid species are considerably harmful phytophages in terms of economics.

The present work was compiled on the basis of the research conducted by us in the Lori region, in 2021–2022, during which studies were carried out in the orchards of the most popular apple and pear varieties in the region, aimed at finding out the aphid population on various trees and developing effective measures against them.

According to the results of the conducted studies, 9 species of aphids were recorded on apple and pear trees, among which representatives of the Aphididae family (8 species) predominate, and the Pemphigidae family is represented by one species.

Based on the results of the statistical analysis of the scientific experiments conducted in 2021–2022, we were able to demonstrate that the indicators of the biological efficiency of the insecticides tested against the phytophagous were accurate with the deviation of the indicators of the experimental error (P) and the coefficient of variation (V) being from 2.8% to 5.3% and from 10.3% to 12.5%, respectively.

Keywords: fruit trees; aphids; phytophagus; insecticides; efficiency; collection

Introduction

Aphids (*Homoptera: Aphidoidea*), are among the most dangerous pests of agricultural crops (Coeur d'acier et al., 2007, Messing et al., 2007, Cooper et al., 2011, Wang et al., 2011) and are widespread (von Dohlen et al., 2006).

More than 4,700 (Coeur d'Acier et al., 2010) to 5 000 species of aphids (Wang et al., 2013) have been described worldwide. According to other literature, the fauna of the aphids consists of approximately 4 400 described species in 500 genus (Blackman and Eastop, 1994).

Pests are one of the main reasons for decrease in fruit crop (Tumanyan, 1953; Vasiliev, 1987; Blackman and East-

top, 2008; Alford, 2014; Ovsyannikova and Berim, 2021).

The most common types of fruits grown in the Lori region of the Republic of Armenia are apple and pear (Sown areas of agricultural crops, planting area of permanent crops, gross harvest and average crop capacity for 2021 – 2022).

Aphids damage plants by feeding on their cell sap. As a result of their feeding, toxicoses are observed in the plant, including necrosis, hypersensitivity reaction, hyperplasia, and the formation of galls, the latter of which is caused by the saliva secreted by the aphid during feeding (Miles, 1999, Cooper et al., 2010). As a result of the latter, the buds are also damaged, the leaves are twisted, and colorless spots appear on the leaves (Hashmi, 1994).

Pests mainly live on young leaves and young shoots. There are species that can cluster on fruit (Vasiliev, 1984; Kolesova, 2005; van Emden and Harrington, 2007; Berim, 2019).

As a result of the pests' life activity, the leaves get distorted, deformed and dry up, the shoots stop growing, and the tops bend. Phytophage sweet secretions (honeydew) pollute the surface of the leaves, disrupt the normal life and photosynthesis of plants. According to Schwartzberg and Tumlinson (2014), the honeydew also has a positive effect, it attracts the natural enemies of aphids. Honeydew of aphids is also a source of carbohydrates for the parasites, extending its life span.

Aphids can infect plants with various viruses, which can lead to even greater damage. All this results in decrease in the quality and quantity of the crop (Mathews, 1973; Savkovsky, 1976; Hull, 2002; Bergun and Storchevaya, 2003; Bosque-Perez and Eigenbrode, 2011; Rakauskas, 2015; Erokhova, 2016; Dementieva, 2017; Kononenko et al., 2020). According to Katis et al. (2007), 50% of plant virus diseases are transmitted by aphids.

Material and Methods

Back in 2021–2022 during vegetation season, we conducted a research to study the aphid population detected on the most common varieties of apple and pear trees in the Lori region. Later, based on the data received from the collected samples, we identified the most common phytophages and determined the dominant species to be able to develop environmentally effective measures against them.

Starting from the “green cone” phenophase once every 7 days visual counting and collecting of the aphids was carried out on the leaves, shoots and inflorescences of each fruit tree species.

Aphids were collected from the plant by carefully shaking them with a soft brush into test tubes. The latter were delivered to the entomological laboratory, recorded in accordance with the methods applicable to entomology (in the 75° alcohol-glycerin solution), and labeled to further clarify the species belonging (Dolgovala, 1979).

The species belonging of the collected pests was verified and identified with the help of various professional determinants (The determinant of insects of the European part of the USSR, 1964; The determinant of harmful and beneficial insects and mites of fruit and berry crops in the USSR, 1984), and by the specialists of the Research Centre of Risk Assessment and Analysis in Food Safety Area.

Researches on the methods of the pest control against aphids were carried out in the orchards of Vahagn community

of the Lori region. The following modern insecticides were selected for the experiments: Calypso (active ingredient: thiacloprid 480 g/l), Wayego (active ingredient: tetraniliprole 200 g/l), Exirel (active ingredient: cyantraniliprole 100 g/l), Lirum (active ingredient: cyantraniliprole 60 g/l + abamectin 18 g/l), and Proteus (active ingredient: thiacloprid 100 g/l + deltamethrin 10 g/l). Arrivo preparation (active ingredient: cypermethrin 250 g/l), which is widely used in the region, was used as a standard sample (for control treatment). Three concentrations of each of the above-mentioned insecticides were tested in triplicate on 20 trees each.

The population of aphids on the fruit trees was estimated according to the following scale:

- 0 point – plants on which aphids were not detected;
- 1 point – plants with the surface inhabited by aphids at 5%;
- 2 points – plants with the surface inhabited by aphids at 6–25%;
- 3 points – plants with the surface inhabited by aphids at 26–50%;
- 4 points – plants with the surface inhabited by aphids at 51%.

We measured the population of aphids, and the biological efficacy of the tested insecticides on fruit trees using the following formula:

$$X = \frac{\sum abc}{n * 4} * 100,$$

where X is the degree of the aphid population on leaves;
 $\sum abc$ is the sum of the points;
 n is the total number of the counted leaves;
 4 is the highest point.

The statistical analysis of the recorded results was carried out according to the formula presented in this scientific work (Mesropyan, 2011).

Result and Discussions

The research revealed that the representatives of the *Aphidoidea* subspecies of the *Homoptera* species are constantly present in the orchards of the Lori region. With the mass reproduction of the aphids, the growth of the trees slows down, young shoots get deformed and, as a result, the cold resistance of the trees decreases, which affects the formation of the fructiferous buds and significantly reduces the crop yield; related references are also available in other literary sources (Savkovsky, 1976; Bergun and Storchevaya, 2003; Lee et al., 2018).

Having studied the aphid population on the fruit trees, we found out that pear trees are relatively less populated by phytophages, while apple trees are more exposed to being populated with aphids. Table 1 shows the results of our study related to the species composition of aphids. The 2021 – 2022 data on the population of aphids on the fruit trees are shown in the graphic image (Fig. 1).

As the data presented in Table 1 show, the studied fruit tree varieties were inhabited by various species of aphids. A total of 9 species of aphids were recorded, representatives of the *Aphididae* family (8 species) being dominant, and the *Pemphigidae* familie being represented with one species.

At the same time, it was proved that apple was mostly more populated and damaged by the *Aphis pomi* Deg., pear was most affected by the *Dysaphis reaumuri* M. (Pear aphid) species.

The remaining aphid species belong to the background species. They are not detected in all the orchards and do damage only during some years.

As it is obvious from the data presented in Figure 1, with the fruit trees studied in 2021, the following values of the aphid population degree were recorded: apple – 62.4%, pear – 33.3%, whereas in 2022 correspondingly: apple – 56.6% and pear – 27.8%.

It is known that aphids are hydrophilous insects; according to Fig. 1, their number in 2022 was relatively low, caused most probably by the fact that atmospheric precipitation in the Lori region that year was below the rate and the year was quite dry.

Biological efficiency data of insecticides used against aphids on fruit trees are presented in Table 2.

The results of 2021 presented in Table 2 show that among the tested insecticides relatively higher biological efficiency

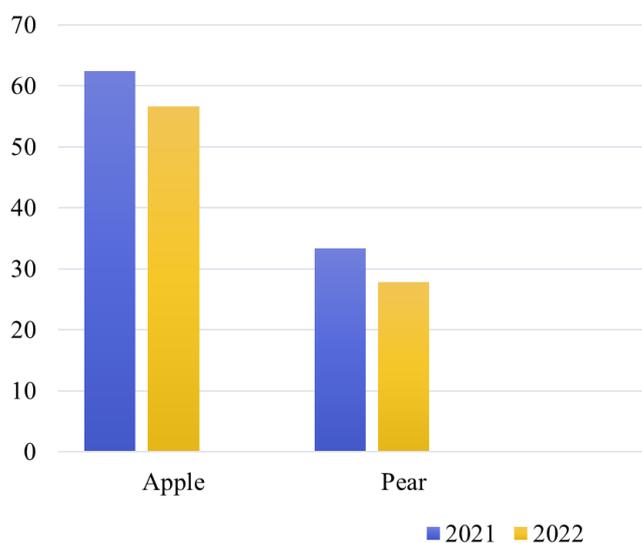


Fig. 1. The population of aphids on apples and pear trees (%) 2021–2022

Source: Authors' own elaboration

on all crops was demonstrated by the following ones: Calypso (0.3 L/ha), Exirel (0.75–1.0), Lirum (1, 5 l/ha), and Proteus (1.0 l/ha). In terms of the biological efficacy, all tested insecticides were superior to Wayego and Arrivo (preparation for control treatment).

The biological efficiency of the above-mentioned four insecticides changed from 79.4% to 92.7%, from 88.7% to 99.1%, and from 74.5% to 89.3% after 3, 9 and 15 days of treatment, respectively. Since the indicators of the biological efficiency in Exirel 0.75 and 1.0 l/ha were relatively close, it would be more logical from the environmental and economic

Table 1. Species composition of aphids affecting the apple and pear trees

Fruit tree types	Variety	Family identity of aphids	Species composition of aphids	Degree of population*
Apple	Golden Delicious	<i>Aphididae</i>	<i>Aphis pomi</i> Deg.	+++
			<i>Dysaphis affinis</i> Mordv.	++
			<i>Dysaphis mali</i>	++
			<i>Dysaphis defecta</i> Walk.	++
			<i>Rhopalosiphum insertum</i> Walk.	+
		<i>Pemphigidae</i>	<i>Eriosoma lanigerum</i> Hausm.	+
Pear	Sini Malacha	<i>Aphididae</i>	<i>Dysaphis reaumuri</i> M.	+++
			<i>Longiunguis pyrarius</i>	++
			<i>Aphis pomi</i> Deg.	+
			<i>Anuraphis pyrilaseri</i> Shap.	++
			<i>Rhopalosiphum insertum</i> Walk.	+
			<i>Dysaphis mali</i>	+

+ low, ++ average, +++ high
Source: Authors' own elaboration

Table 2. Biological effectiveness of the insecticides against Aphids in Vahagni community

Insecti-cide	Active ingredient	Consumption norm l/ha, kg/ha	Type of fruit tree	Biological efficiency (%) by year and day					
				2021			2022		
				3	9	15	3	9	15
Kalipso	Tiaklopid (480 g/l)	0.2	Apple	76.6	85.0	70.2	80.8	87.4	71.6
			Pear	68.4	73.6	65.0	60.3	73.1	64.8
		0.3	Apple	91.5	98.4	88.0	93.3	97.1	94.0
			Pear	88.6	92.0	85.6	87.9	91.8	88.6
Vayego	Tetraniliprol (200 g/l)	0.15	Apple	61.2	65.0	54.3	60.9	65.6	51.0
			Pear	55.5	60.4	51.2	60.0	63.1	47.2
		0.2	Apple	67.0	72.4	62.1	70.6	73.0	58.5
			Pear	61.3	70.5	60.3	63.4	71.5	55.1
Exirel	Ciantranil-ipro (100 g/l)	0.75	Apple	81.2	90.6	82.2	81.5	92.6	83.4
			Pear	79.4	88.7	74.5	76.4	89.8	76.3
		1.0	Apple	83.0	94.9	84.6	85.5	95.7	82.1
			Pear	80.8	90.4	80.7	80.1	88.8	79.5
Lirum	Ciantranil-ipro+ abamectin (60 g/l+ 18 g/l)	1.0	Apple	75.4	87.6	73.2	74.6	88.0	73.1
			Pear	70.2	83.5	70.7	72.0	85.7	75.6
		1.5	Apple	91.4	99.1	84.0	89.6	97.5	85.3
			Pear	86.6	93.5	78.6	88.0	93.3	80.0
Proteus	Tiaklopid+ Deltametrin (100 g/l+10 g/l)	0.5	Apple	82.4	88.5	73.1	80.6	85.0	78.0
			Pear	76.0	80.7	69.5	74.3	81.8	67.4
		1.0	Apple	92.7	98.0	89.3	90.5	95.7	84.5
			Pear	89.5	93.4	82.0	83.3	91.1	80.2
Control Arrivo	Cypermeth-rin (250 g/l)	0.3	Apple	76.5	83.4	69.5	80.0	85.3	78.1
			Pear	68.0	78.6	66.2	76.4	82.0	70.5

Source: Authors' own elaboration

point of view to offer the farmers the lower consumption rate of this preparation, i.e. 0.75 l/ha.

Similar results were found in the tests performed in 2022.

Based on the results of the statistical analysis of the scientific experiments conducted in 2021–2022, we were able to demonstrate that the indicators of the biological efficiency of the insecticides tested against the phytophagous were accurate with the deviation of the indicators of the experimental error (P), and the coefficient of variation (V) being from 2.8% to 5.3% and from 10.3% to 12.5%, respectively.

Conclusion

As a result of the research carried out in 2021 – 2022, it was found out that the orchards of the Lori region are harmed by 9 species of aphids, whereof pear and apple trees are affected by 6 species each.

It was proved that apple trees were most populated and damaged by the *Aphis pomi* Deg. species, the pear trees were most harmed by *Disaphis reaumuri* M. species.

Based on the experiments carried out in the orchards of

Vahagn community of the Lori region during 2021–2022, we may conclude that Calypso (0.3 l/ha), Exirel (0.75), Lirum (1.5 l/ha), and Proteus (1.0 l/ha) insecticides have shown the best results in the pest control against aphids.

Conflict of Interests

The authors declare that there is no competing interest.

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