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The Habitation and Damage of Mite in Apple and Plum Tree Orchards of Armavir Region

Samvel Asatryan
Armenian National Agrarian University
samvel.asatryan.96@gmail.com

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ABSTRACT

In 2021-2022, a study of herbivorous (phytophagous) mite habitation and harmfulness was conducted in apple and plum orchards in the Armavir region (RA). Research findings of two-year scientific experiments confirmed that between the two apple varieties the Star Crimson variety had the highest habitation rate of Hawthorn Red Spider Mite (Tetranychus viennensis Zacher), specifically 52.7 % in the first year, and 55.5 % in the second year. Among the three plum varieties, Vengerka Italian had the highest habitation rate (49.5 and 53.2 %, respectively) of common spider mites (Tetranychus urticae Koch). Research findings also confirm that at the peak of leaf damage, compared to the Golden Delicious apple variety, the damage caused by Hawthorn Red Spider Mite to the leaves of the Star Crimson apple variety was high in 2021-2022 (43.5 % and 45.0 % respectively). There was relatively high damage caused by Hawthorn Red Spider Mite to the "Vengerka Italian" variety in 2021 and 2022 (39.9 % and 41.0 %, respectively). Effective control measures against phytophagous mites with high habitation in apple and plum orchards will be developed and offered to farmers.

Introduction

Herbivorous (phytophagous) mites are considered one of the primaries of pest and disease control since they cause significant damage to fruit trees (Dilbaryan and Kocharyan, 2014; Manvelyan and Asatryan, 2018).

In fruit trees, phytophagous mites actively develop in various organs (mainly leaves, sometimes leaves, sometimes fruits) causing some pathological processes. Due to mite nutrition, many vital biological processes in plant cells, include photosynthesis and respiration. In addition, metabolism almost stops, cells are mostly empty and filled with air, and the cell wall turns gray. Over time, necrotic (dead tissue) spots appear on the leaves of heavily damaged trees, multiplying and coalescing, causing the leaves to dry out and fall prematurely. Due to the reduction

of photosynthetic surfaces, fruit quality drops. The offshoot rate of growth slows down, they become pale, sometimes non-fruitful (Arutyunyan and Dilbaryan, 1986; Melikyan, 2007).

Among the many orchards studied in the scope of the scientific experiments over several years, apple and plum trees were singled out as the most inhabited and the most damaged by herbivorous mites. According to the research findings, a total of 9 types of harmful mites were found and identified, 7 of which were tetranychoid and 2 were tetrapod (Terlemezyan and Asatryan, 2021).

Materials and methods

Apple and plum varieties were included in the 2021-2022 experiments. The goal was to identify the habitation and damage of the mentioned fruit orchards by herbivorous mites. During the vegetation period, 50 leaves (in several cases also young branches and fruits) from 20 trees of each fruit type were counted every 7 days.

The assessment of the habitation (damage) of different varieties of apple and plum by herbivorous ticks was performed on the following scale:

0 points - leaves, as well as other vegetative and generative organs, that were not infested with mites. 1 point - leaves and sometimes other vegetative and generative organs inhabited or damaged by mites on 5% of their surface.

2 points - leaves, and, in some cases, other vegetative and generative organs, with 6-25% of the surface covered in mites.

3 points - leaves, and sometimes other vegetative and generative organs, with 26-50% of the surface infested or damaged by mites.

4 points - leaves and, in some cases, other vegetative and generative organs infested or damaged by ticks on more than 50% of their surfaces.

The assessment of the habitation of different apple and plum varieties was performed according to the following scale:

0 points – leaves on which no mites were found,

1 point - leaves on which 1 to 10 mites were found,

2 points – leaves on which 11 to 20 mites were found,

3 points - leaves on which 21 to 30 mites were found,

4 points – leaves on which 31 or more mites were found (Manvelyan, 2004; Melikyan, 2007; Harutyunyan, 2018).

The habitation and damage of ticks in leaf mass fruit trees was determined by the following formula:

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

where X – is the habitation of leaves with ticks or the harmfulness, $\sum abc$– is the sum of the points, n – is the total number of counted leaves or other observed organs, 4 – is the maximum points value (Livshits, 1964; Terlemezyan, et al., 2022).

Results and discussions

During the 2021-2022 vegetation period, nine species of harmful mites were observed and identified on five varieties of apple and plum trees. seven of which were tetranychoid and two were tetrapod. There were nine mite species observed on different varieties of apple and plum, but two caused the most damage. These two mite species are the Hawthorn Red Spider Mite and the Common Spider Mite. The indicators of habitation and habitation degree of the Hawthorn Red Spider Mite and the Common Spider Mite observed on different apple and plum trees in 2021-2022 are presented in Tables (1 and 2).

According to Table 1, mite habitation and habitation degree increased in 2022 compared to 2021. In particular, if, in 2021, the indicators of the Hawthorn Red Spider Mite were 52.7 % and 48.0 % in the Star Crimson and Golden Delicious varieties, then, in 2022, the indicators of the latter were 55.5 % and 49.1 %, respectively. In the case of the two apple varieties with Hawthorn Red Spider Mite, the indicators were 60.1 % and 56.8 % in 2021 and 63.8 % and 57.4 % in 2022, respectively.

Table 1. The habitation and habitation degree of apple varieties with Hawthorn Red Spider Mite (Aygevan, 2021–2022)*

	Variety	Habitation, %		Habitation degree, %	
		2021	2022	2021	2022
Apple tree	Star Crimson	52.7	55.5	60.1	63.8
	Golden Delicious	48.0	49.1	56.8	57.4

*Composed by the author.

Research findings confirm that the most sensitive varieties were the Star Crimson apple and Vengerka Italian plum. The highest habitation rates and habitation degree of Hawthorn Red Spider Mite and Common Spider Mite were recorded, respectively.

Table 2 shows a similar pattern for the three plum varieties (Vengerka Italian, Vengerka Domestic, and Victoria).

Table 2. The habitation and habitation degree of plum varieties with the Common Spider Mite (Aygevan, 2021–2022)

	Variety	Habitation, %		Habitation degree, %	
		2021	2022	2021	2022
Plum tree	Vengerka Italian	49.5	53.2	56.7	58.8
	Vengerka domestic	47.0	51.8	53.1	56.2
	Victoria	43.9	46.4	50.1	53.5

*Composed by the author.

In 2021, the habitation of the Vengerka Italian variety with Common Spider Mite was 49.5 %, and the habitation degree was 56.7 %. In the same year, Vengerka Domestic and Victoria varieties had habitation indicators of 47.0 % and 43.9 %, respectively, and habitation degree of 53.1 % and 50.1 %, respectively.

In 2022, the following indicators were recorded in terms of habitation: Vengerka Italian - 53.2 %, Vengerka Domestic-51.8 %, and Victoria - 46.4 %. Regarding the habitation degree, the indicators were the following: Vengerka Italian - 58.8 %, Vengerka Domestic - 56.2 %, and Victoria - 53.5 %. Of the five studied varieties, only the Star Crimson apple and Vengerka Italian plum varieties had high habitation indicators. Relatively low habitation degrees were recorded in Golden Delicious apple, Vengerka plum, and Victoria varieties, which is mainly due to the morphological and biochemical differences between the varieties (in particular the softness of the lower leaf skin, the thickness of the cell wall in the epidermis layer, the maturity of the plant tissues and the chemical composition of cellulose).

The number of generations formed by phytophagous mites during vegetation and the density of the local group (population) depend on the value of the Hydrothermal Index (HMI): the higher the average daily air temperature and the less precipitation, the greater the number of generations formed and the greater the population density on the leaf surface (Balyakina et al., 2021).

According to the data of the "Hydrometeorology and Monitoring Center" of the Ministry of Environment of RA, the years 2021 and 2022 were favorable for herbivorous mite growth and reproduction. In recent years, due to global climate change, a slight but continuous increase in air temperature has been observed. At the same time along with the increase in temperature, a decrease in atmospheric precipitation was observed (www.arm-monitoring.am). As a result, the years 2021 and 2022 were no exception, resulting in favorable conditions for mite reproduction and growth. Sometimes, the homogeneity of the average daily air temperature, the absence of sharp fluctuations, and the low amount of atmospheric precipitation during vegetation indirectly contributed to the formation of a large mite population in apple and plum orchards.

Star Crimson apple variety had a higher mite population index in both years of the study than Golden Delicious according to comparative analyses of apple and plum varieties. Similar results were observed with plums: the habitation data of the Vengerka Italian variety exceeded the indicators of the Vengerka Domestic and Victoria varieties.

The studies conducted in 2021-2022 also revealed the damage caused by phytophagous mites to different apple and plum varieties. The research findings confirm that in the case of apple trees (in 2021 and 2022), the Star Crimson variety was the most damaged by herbivorous mites, particularly the Hawthorn Red Spider Mite. Damage to the Golden Delicious variety was moderate.

In the case of plums (in 2021 and 2022), the highest rates of damage caused by the Common Spider Mite were recorded for the Vengerka Italian variety. Figures (1 and 2) present leaf mass damage data for the mentioned varieties (Star Crimson and Vengerka Italian) during the vegetation period.

The data presented in Figure 1 shows that the highest damage rates caused by the Hawthorn Red Spider Mite to the leaf mass of the Star Crimson apple variety were recorded between July 3-17, 2021-2022. Leaf damage peaked on July 3 in 2021 (43.5 %) and July 10 in 2022 (45.0 %).

In both years, the maximum damage indicators (peaks) differed by 7 days, primarily due to ecological and other factors.

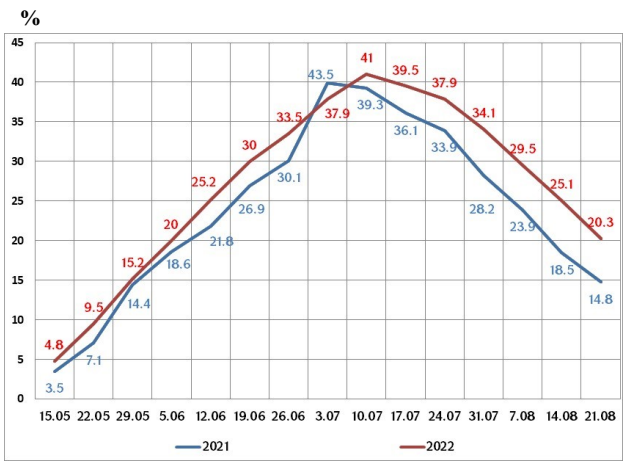

Figure 1. Damage of the hawthorn red spider mite to the Star Crimson variety by days of observation *(composed by the author).*

Among the three plum varieties observed in the two years of the experiments, the highest rates of damage by the Common Spider Mite were recorded on the Vengerka Italian variety (Fig. 2). The results of the observation confirm that the highest rates of leaf damage were recorded in July for both years of the experiments (on July 3, 2021- 39.9 %, on July 10, 2022 - 41.0 %). The leaf mass was relatively weakly damaged in the other apple and plum varieties.

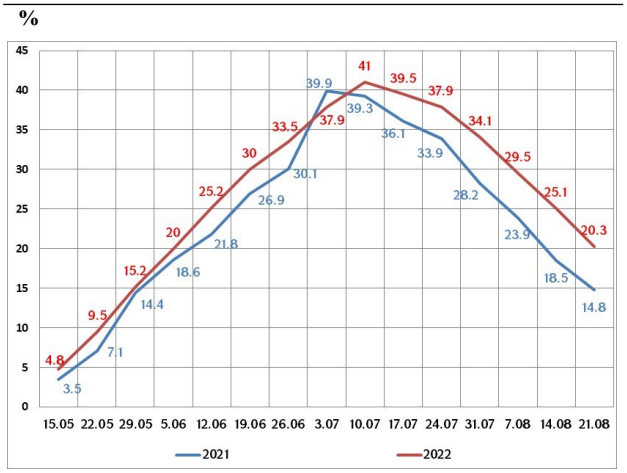

Figure 2. Damage of the Common Spider mite to the Vengerka Italian variety by days of observation *(composed by the author).*

Conclusion

The research findings indicate that, in 2021-2022, among the five studied apple and plum varieties, herbivorous mites (Hawthorn Red Spider Mite and Common Spider Mite) most strongly inhabited the Star Crimson apple and Vengerka Italian plum varieties. The Hawthorn Red Spider Mite habitation of the Star Crimson variety was 52.7 % in 2021 and 55.5 % in 2022. In the case of the Italian Vengerka variety, the indicators were 49.5 and 53.2 %, in 2021 and 2022 respectively.

Only two of the five studied varieties, the Star Crimson apple, and the Vengerka Italian plum, had the highest leaf damage rates. As a result, one variety of apple trees and one plum tree, most damaged by herbivorous ticks, were identified. Star Crimson apple varieties suffered the most damage during the peak in two years: 43.1 % in 2021 and 45.0 % in 2022. For plum trees, the Vengerka Italian variety suffered the most damage: the leaf mass damage during the peak was 39.9 % in 2021 and 41.0 % in 2022.

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Declarations of interest

The author declare no conflict of interest concerning the research, authorship, and/or publication of this article.

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