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SOME TYPES OF SUCKING PESTS OF STONE FRUIT TREES IN THE SHAKI-ZAKATALA REGION AND THEIR ENTOMOPHAGE

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НЕКОТОРЫЕ ВИДЫ СОСУЩИХ ВРЕДИТЕЛЕЙ КОСТОЧКОВЫХ ПЛОДОВЫХ ДЕРЕВЬЕВ В РАЙОНЕ ШАКИ-ЗАКАТАЛА И ИХ ЭНТОМОФАГИ

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Abstract. In Azerbaijan, and in the Shaki-Zagatala region, rich in orchards, valuable stone fruit trees are grown, which formed the basis of this work. The area of stone fruit orchards is increasing annually. To achieve higher yields, a pest protection plan was developed and implemented. A key issue is the identification of stone fruit tree pests and the timely and effective implementation of control measures. From 2001 to 2013, field and laboratory studies of stone fruit tree pests and their entomophages were conducted in the districts of Balakan, Zagatala, Shaki, Kash, Oguz, Gabala, and Ismaili. The districts of Zagatala, Shaki, Ismaili, and Gabali were selected as permanent sites. The study of the species composition, biological characteristics and economic significance of pests of fruit and forest trees and their entomophages opens up opportunities for the use of entomophages in the fight against harmful insects.

Аннотация. В Азербайджане, и в Шаки-Закаталском регионе, богатом садами, выращиваются ценные косточковые плодовые деревья были проведены исследования, которые легли в основу данной работы. Площадь садов косточковых плодовых деревьев ежегодно увеличивается. Для получения более высокого урожая был разработан и реализован план защиты этих деревьев от вредителей. Одним из важнейших вопросов является выявление вредителей косточковых плодовых деревьев и своевременное и эффективное применение мер борьбы с ними. В период с 2001 по 2013 год в районах Балакен, Закатала, Шаки, Каш, Огуз, Габала и Исмаили в полевых и лабораторных условиях проводились полевые и лабораторные исследования материалов, связанных с изучением вредителей косточковых плодовых деревьев и их энтомофагов. В качестве стационарных пунктов были выбраны районы Закатала, Шаки, Исмаили и Габала. Изучение видового состава, биологических характеристик и экономического значения вредителей плодовых и лесных деревьев и их энтомофагов открывает возможности для использования энтомофагов в борьбе с вредными насекомыми.

Keywords: fruit trees, fruit tree pests, Azerbaijan, tree protection.

Ключевые слова: плодовые деревья, вредители плодовых деревьев, Азербайджан, защита деревьев.

According to recent literature data, up to 300 species of insects damage fruit trees, including stone fruit trees in Azerbaijan [1].

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Biological control against fruit pests in Azerbaijan was first applied in 1926, namely, for the purpose of combating the woolly apple aphid in the Zaqatala region, the aphelinus parasite was brought from Italy by Rajabli and Meyer. Starting from 1960, continuous research work has been carried out under the conditions of Quba-Khachmaz, Shaki-Zaqatala, and Nakhchivan Autonomous Republic on the study of garden pests and their entomophages [2-7].

Thus, the study of the species composition, bioecological characteristics, and economic importance of garden pests and their entomophages creates broad opportunities for combating harmful insects using entomophages.

Materials and Methods

In the Shaki-Zaqatala area, the collection and processing of materials related to the study of stone fruit pests and their entomophages was carried out in the districts of Balaken, Zaqatala, Shaki, Qax, Oghuz, Gabala, and Ismayilli under field and laboratory conditions during the years 2001–2013.

As stationary points, the districts of Zaqatala, Shaki, Ismayilli, and Gabala were selected. In the process of collecting materials, during the identification of pests and entomophages, special identification sources were used [3, 6].

Results and their analysis

As a result of the entomological research carried out, it was determined that in the Shaki-Zaqatala region, 4 species of aphids belonging to the family Aphididae of the order Homoptera and 8 species of scale insects belonging to the family Coccidae are spread in stone fruit orchards and cause damage to farms to varying degrees, and that the bioecological characteristics, economic importance, parasites, and predators of some of them have been studied.

Plum aphid – *Hyalopterus pruni* Geoffr. The pest belongs to the order Homoptera, family Aphididae. The wingless adult forms of the plum aphid are pale green in color, and on its body, there are three dull green longitudinal stripes. Its head part is elongated in shape and covered with a white wax layer. On the thorax and abdomen, two rows of white dots are arranged. The body length is 2.5–3 mm. In the winged individuals, the head and thorax are black, covered with a wax-like gray layer. The abdomen is green. The larva is smaller than the adult individuals and resembles them in external appearance. The egg is small, black in color, and elongated. The plum aphid, by damaging plum, peach, apricot, almond, cherry plum, and other stone fruit trees, is widely spread in the forest and fruit areas of the Shaki-Zaqatala zone. It is a migratory aphid; part of its life is spent on the fruit trees it feeds on, and the rest on the reed plant. This pest overwinters at the fertilized egg stage on the edges of buds of plum, peach, and apricot trees, or in the cracks of the bark.

In early spring (at the end of March, at the beginning of April), the larvae emerging from the overwintered eggs move to the buds that have just begun to open and suck their internal contents. Until the end of the flowering of the trees, the development of the larvae that emerged from the eggs is completed and they turn into female individuals that continue the generation. These individuals give birth to live larvae. Usually, the number of larvae of the first generation is not large. Starting from the second generation, the quantity of larvae increases considerably and they live on the leaves in the form of colonies. From June onwards, a part of the winged forms of this generation move onto the reed plants located at the edges of the canals and there they form the beginning of a new generation. Thus, the plum aphid develops simultaneously both on fruit trees and on reed plants during the entire summer period. In September–October, the individuals continuing the generation of the aphid on the reed plant are not very productive. During their one-month lifetime, they lay up to 10 eggs and then die. The formed larvae develop and turn into normal female individuals. They mate with male individuals, fertilize, and within 10–12 days lay up to 5 eggs, covering them with a wax-

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like liquid. These eggs overwinter. The plum aphid is a serious pest of stone fruit trees. As a result of the trees being infected by it, the leaves curl, in such leaves the area of the photosynthetic surface sharply decreases, and even in some cases leaves and flowers fall to the ground massively. On the other hand, when the aphid feeds, it secretes a sticky substance, on which saprophytic fungi develop and multiply, polluting and destroying the branches and leaves.

According to the conducted research, among the aphid colonies on the leaves, the larvae of chrysopids (lacewings), coccinellids (lady beetles), and syrphid flies were detected. The larvae of these beneficial entomophages feed in a complex manner on the aphids and reduce their number by 18–22%.

Green peach aphid – *Myzodes persicae* Sulz. This pest also belongs to the order Homoptera. It is a migratory aphid. It is large, grayish-brown in color. On its back there is a longitudinal row of black warts. The pest lives in large clusters on the bark of the trunks and on the lower surfaces of the branches of peach, almond, apricot, and cherry-plum trees. The development of the larvae is completed at the end of March and in the first ten days of April when the average daily air temperature is 15–16°C. For them to pass into the adult stage, 16–30 days are required. The first live-bearing winged females are encountered in May, and during the summer season they increase. They can also be encountered at the end of September and even at the beginning of October. Since it is a permanent species, depending on the season, it is more often encountered on fruit trees. In egg-laying females, the reproduction ability is high. The number of eggs reaches 13–18. They lay their eggs on the lower sides of branches, in shady places. For the development of the eggs, the optimal temperature is considered to be 25–28°C. The overwintering period is completed at the egg stage. During the year, it gives 8–9 generations.

In the Shaki-Zaqatala region, being considered the most dangerous pest of peach and almond trees, the sooty mold that forms as a result of the liquid it secretes also causes serious damage to these trees. Among its natural enemies, the two-spotted lady beetle, the colosoma beetle, and the larvae of lacewings can be mentioned. The beetles, in a complex manner, act at a high degree in the bioregulation of the pest's number.

Plum scale insect – *Sphaerolecanium prunastri* F. In Shaki-Zaqatala, it causes serious damage to plum and peach trees. It is mainly considered a pest of stone fruit trees belonging to the genus *Prunus*. Apart from fruit trees, it also damages ornamental plants.

The body of the female individual of the plum scale insect is elongated. The front part of the body is narrow. It has a dark brown color. The shell is yellowish in the front part. Its length is 3–4 mm, and its width is 3–3.2 mm. In the dorsal area there are small hairs. The antennae of the female individual consist of six segments. The male individual is winged, reddish in color, its legs are covered with hairs, it has thin, long antennae consisting of ten segments. The length of its body is 1.5–1.8 mm.

According to observations, the scale insects appear at the end of March and the beginning of April. The male individuals begin to fly in May. The female individuals gradually begin to lay eggs – "to give birth" – at the end of May. The eggs laid by the female individual are reddish in color, their length is 0.4 mm, and their width is 0.3 mm. At the time of laying, there are already mature larvae inside them. The first instar larvae are reddish in color, elongated in shape. They have antennae consisting of six segments. On the edges of the body there are thirteen pairs of hairs. The second instar larvae are oval in shape. Their surface is slightly swollen. Their color is yellow, sometimes reddish, with black dots on them. On the edges of the body there are nineteen pairs of hairs. The surface of the body is covered with secretions. They overwinter in the second instar larval stage.

When the trees begin to blossom, they awaken from winter sleep and start feeding on the sap of the plant. In May, male individuals appear. During this period, fertilization takes place. Within one

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month, the female individual begins to lay eggs. They are capable of laying up to 3000 eggs. Then larvae emerge from the eggs. In August, second instar larvae are encountered, which attach themselves to the branches and overwinter. It gives one generation per year.

Peach scale insect – *Parthenolecanium persicae* F. The body of the female individual of the peach false scale insect (*Parthenolecanium persicae* F.) is oval in shape. It has a dark brown color. In young females, there are stripes on the body, which after some time disappear, and the body becomes completely brown in color. Its length is 3 mm, and its width is 2.5–2.7 mm. It has long thin legs and long antennae. The antennae usually consist of eight segments. The edge of the body is covered with small hairs. According to the research, in the Shaki-Zaqatala region it develops in one generation. They mainly overwinter in the second instar larval stage. The larvae gradually begin to awaken in April. Egg-laying takes place at the end of May, and the emergence of larvae occurs in the middle of June. During egg-laying, the female individuals enlarge, and the underside of the shell becomes filled with eggs. The eggs are yellow in color. The developing eggs change their color, turning into orange–reddish.

In the region, one female individual lays up to 2500 eggs. The trees, in the second half of summer, become infected with first instar larvae. As a result, the leaves dry and turn yellow. The first instar larvae live on the veins on the underside of the leaves, while the older larvae and females live on the trunk and branches. Within one–two months, the larvae develop and pass into the second instar stage. On both sides of the body of the larvae there are thin wax-like threads. Until autumn, the second instar larvae remain on the leaves. Then they move to the branches to overwinter (Table 1).

Table 1

PHENOLOGY OF THE PEACH SCALE INSECT (*Parthenolecanium persicae* F.)
IN THE SHAKI-ZAQATALA REGION (2022–2023)

Observed place	*march*			*april*			*may*			*june*			*july*			*august*			*september*		
	1	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*
Shaki	s	s	s	s	s																
				d	d	d															
						(d)	(d)	(d)													
								a/s	a/s	a/s											
								s	s	s	s	s	s	s	s	s	s	s	s	s	
																		s.	s.	s.	s.
																		s	s	s	s
Zaqatala	s	s	s	s	s	s															
						d	d	d	d												
								(d)	(d)	(d)	(d)										
										a/s	a/s	a/s									
										s	s	s	s	s	s	s	s	s			
																	s.	s.	s.	s.	
																			s	s	s

Note: s - I instar larvae; s. - II instar larvae; s - III instar larvae; d - female individual (young); (d) - egg-laying females; a/s - “wanderers” under the egg

In the Shaki-Zaqatala area, 6 species of entomophages functioning in the reduction of the number of the peach scale insect have been identified. The peach false scale insect has been recorded in the Russian Federation, the Caucasus, Kazakhstan, Turkey, Iran, India, Australia, and other countries [1, 4, 6, 7-11].

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In 2022–2023, as a result of the study of the entomophages of sucking pests of trees in the forest and orchard agrocenoses of the Shaki-Zaqatala area, the following species were determined to be widely spread and more effective.

Adalia bipu nctata L. The two-spotted Adalia lady beetle is widely spread in every district of the Shaki-Zaqatala region, occupying one of the main places in the bioregulation of forest and fruit tree pests. This predatory beetle is considered the primary enemy of the green peach aphid. Unlike other lady beetle species, they are not encountered on other agricultural plants. The egg of the two-spotted Adalia is 0.7–1.0 mm in size, narrow, rod-shaped; the color of fertilized eggs is light yellow, while the color of unfertilized ones is light orange. Its larvae are broad (especially in the front part) and somewhat flattened, light brown in color, with white or yellow spots on them. The length of the larva in the last instar (4th instar) is 7–8 mm. The sides of the head capsule are dark brown, and the prothorax is broad. The head, mouthparts, and antennae of the adult Adalia are light brown in color, the femur and tibia are mainly white, and the elytra are red. On each elytron there is one black spot; sometimes they are reddish-black, and in such cases the spot appears red. The length of the beetle is 3.5–5.0 mm. In addition, under laboratory conditions, the lifespan of female individuals of the two-spotted Adalia and the reproductive capacity of each female have been determined (Table 2).

Table 2

EGG-LAYİNG CAPACİTY OF THE TWO-SPOTTED PARAKEET (İN DİFFERENT YEARS)

Experiment time	*Lifespan*	*Number of eggs laid per day*	*The number of eggs laid by one female*	
			Min	*Max*
2022	27	15-17	402	460
2023	28	16-17	431	470

Twelve eggs of the lady beetle were encountered in nature in June 2022 in the Oguz district, in a household plot, among a cluster of aphids on plum leaves. In the experiments, the female Adalia lived at most 28 days, during which it laid 476 eggs, on average 15–16 eggs per day. Alongside the egg-laying ability of the two-spotted Adalia, its voracity was also studied under laboratory conditions.

Both female and male individuals, as well as the larvae of the beetle, were fed with peach and plum aphids. The feeding of the imago and of the larvae at different instars was specially recorded. The results of these experiments are given in the following table (Table 3).

Table 3

VORACITY OF THE TWO-SPOTTED LADY BEETLE (*Adalia bipunctata* L.) ACROSS DIFFERENT YEARS

	Type of food	*Lifespan of the imago*	*Quantity of aphids eaten by lady beetles at different developmental stages*							*Quantity of aphids eaten during the development of one generation*
			Eaten by imago		*Eaten by larvae (at different instars)*				*Summa*	
			During the day	*Sum*	*I*	*II*	*III*	*IV*		
2022	Aphid	27	51	1377	24	30	71	128	253	1630
2023	-	28	60	1680	21	29	67	124	241	1921

As can be seen from the table, one female Adalia (imago) consumed on average 51 aphids per day, and during its lifetime (27 days) ate 1377 aphids. Its larvae, in the first instar, consumed 24 aphids; in the second instar, 30 aphids; in the third instar, 71 aphids; and in the fourth instar, 128 aphids. One larva, throughout its entire development, consumed a total of 248 aphids. During the research, the developmental dynamics of the two-spotted lady beetle were also studied. The newly laid eggs of the Adalia beetle are yellow in color. After two days, their color becomes somewhat

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lighter, while inside they darken slightly. This condition indicates that the embryo inside the egg has already begun to form. Therefore, such eggs generally appear somewhat darkened.

The young larvae of Adalia mainly attack small aphids. Older larvae, especially those in the fourth instar, attack both wingless females and winged aphids, greedily consuming them and sucking the sap from their bodies. After hatching from the egg, the larvae of Adalia pass through four instars during their development, molting three times. As seen from the above information, the development of one generation of the two-spotted lady beetle lasts 20–21 days, including 4–5 days for egg development, 10–11 days for larval development, and 5–6 days for pupal development (at an average daily temperature of 22°C).

Chilocorus bipustulatus L. In the fruit orchards of the Shaki–Zagatala region, the Chilocorus beetle, especially from the family Coccinellidae, is considered more promising in regulating the host population. In the nymph stage (not yet sexually mature), they overwinter under the bark of trees. When the average daily temperature is 12–16 °C and humidity is 60%, they emerge from overwintering between April 12–15. After feeding for several days, they begin mating. One to two days after mating, they lay eggs (Table 4).

Table 4

PHENOLOGY OF THE TWO-SPOTTED CHILOCORUS (*Chilocorus bipustulatus* L.) IN THE SHAKI-ZAGATALA REGION

Year and place of the experiment	*Months*											
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*
2022 Shaki	⊕	⊕	⊕	+	•_	+	+_	++	+	+	⊕	⊕⊕
	⊕	⊕	⊕	+•	_	+	0	+	+	⊕	⊕	⊕
		⊕	⊕	•	_	+	_0		+	⊕	⊕	
					0	•	+					
					+	•						
2023 Zaqatala	⊕	⊕	⊕	+	•	0	+	++	+	+	⊕	⊕⊕
	⊕	⊕	⊕	+•		+	0	+	+	⊕	⊕	⊕
	⊕	⊕	⊕	•	_	+	_0		+	⊕	⊕	
					_	+	+					
					_	•						
						•_						

Note: • egg, -larva, 0 pupa, + imaqo, ⊕ overwintering beetle

They lay their eggs on the thin branches of trees and on the underside of leaves in places where scale insects are settled. When the average daily temperature is 15–18°C and humidity is 70–75%, the egg stage lasts 12–15 days, the larval stage 24–26 days, the pupal stage 6–8 days, and the imago stage 35–40 days. The development of one generation takes 40–45 days. Under the conditions of Shaki–Zagatala, the beetle produces two generations per year. In natural conditions, the young larvae consume 4–12 scale insects, while the older larvae consume 18–20 scale insects. In the imago stage, they feed on 25–30 scale insects per day. The beetle is widely distributed in the forests and orchards of the region and has great economic importance.

Chrysopa carnea Steph. The common lacewing is distributed in the districts of the Shaki–Zagatala region in lowland, foothill, and partly mountainous areas. Under natural conditions, it is the most useful and effective predator regulating the population dynamics of pests. It is more noticeable in the lower tiers of stone-fruit trees in orchards and forest areas. In the evenings, they eagerly gather around electric lights. In stationary experimental plots, many observations were made on the

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bioecological characteristics and economic importance of this predator lacewing, and the following issues were studied. The adult individuals (imago) of the common lacewing are whitish-green in color, and from May until October in orchards and forest areas they reproduce and destroy pests, especially sucking pests (aphids and scales). The eggs and larvae of this beneficial predator are most often found on the leaves of apricot, cherry plum, plum, peach, and forest trees. They feed mainly on aphids.

Under room conditions at 24–26°C, the egg stage of the common lacewing develops in 2–3 days, the larval stage in 7–10 days, the pupal stage in 8–14 days, and the complete development of one generation takes 17–27 days. Under orchard conditions, based on observations on branches enclosed in gauze bags, egg development lasts 3 days, larval development 21 days, pupal development 9 days, and the complete development of one generation takes 33 days. Eggs are mostly laid near clusters of aphids so that the larvae hatching from them can feed on aphids. Observations have shown that young larvae feed mainly on pest eggs and young aphids, while older larvae feed on small caterpillars of various sizes and large aphids. After feeding for 3–4 weeks, the larvae in their final instar turn into pupae. Pupae can be found under tree bark in the form of white silk balls. Adult individuals, after emerging from pupae, mate, and after a few days (2–3 days) begin to lay eggs. Their adult forms overwinter mainly under tree bark, singly or in groups, with each group numbering from 2–3 up to 50–60 individuals. In spring, at the end of April and the beginning of May, adults emerging from overwintering sites feed on flower nectar and pollen, as well as the sweet liquid secreted by aphids. The common lacewing is capable of laying 350–650 eggs. According to calculations carried out on fruit plants, one lacewing larva feeds on 25–30 aphids per day, and throughout its lifetime consumes 400–850 aphids. They show particularly strong predatory activity on apricot, peach, and plum aphids. They molt twice: the first molt lasts 3 days, and the second molt lasts 7 days.

The common lacewing is highly active in reducing peach, plum aphids, and other pests. From this point of view, it can be concluded that, considering the preservation of the common lacewing in nature and its role in regulating the number of pests, it is advisable to reduce the amount of chemicals sprayed in the fields and to carry out control measures on a scientific basis.

Thus, the study of the species composition, biological characteristics, and economic importance of orchard and forest tree pests and their entomophages creates opportunities for using entomophages in the fight against harmful insects.

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