

Almond pest in forest agrobiocenosis and measures against them

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Abstract. In this research, almond pests in forests and identified measures were studied. According to the results of the research, the main pests of the genus *Lepidoptera* in forestry were almonds (*Erschoviella musculana* Ersch.), Oriental fruit on the branches, unequal silkworm on the leaves (*Lymantria dispar* L.) and fragrant wood on the body). It was noted that walnut pest was the dominant among the observed pests. The results of the experiment on almond pests represented that 12 species of entomophagous almonds were recorded, including *Braconidae*, *Trichogrammatidae*, *Ichneumonidae*, *Chalcidoidea*, *Pteromalidae*, *Encyrtidae*, *Tachinidae*, *Coccinellidae*, *Chrysopidae*. Furthermore, representatives of the families of *Miridae*, including *Microgaster nemorum* Hrtg., *Microdus rufipes* Nees., *Macrocentrus delicatus* Cress., *Ascogaster quadridentatus* *Trichogramma embryophagum* Htg., *Trichogramma evanescens* Gir., *Diadegma armillatus* Grav., *Pimpla inquisitor* Scop., *Liotrifon punctulatus* were identified. *Avaunt* with 15% (0.5 l/ha) and *Mospilan* with 20% (0.4 kg/ha) were used against the main almond pests, and biological efficiency was achieved by 88.8% and 94.8%, correspondingly.

1 Introduction

Continuous improvement of measures to combat pests of agricultural crops and the development of methods for the application of new technologies based on science are important. One of the most pressing issues is the development of science-based control measures, environmentally friendly and resource-saving methods for the protection of walnut crops from diseases and pests [1-3, 7]. Furthermore, providing the population of Uzbekistan with quality food products is one of the main tasks facing agriculture. It is also necessary to increase the yield and quality of fruits of ordinary walnut trees, mainly to increase the production of nuts, which are competitive in domestic and foreign markets [8, 9]. Today, reforms are being carried out systematically in all spheres of agriculture, and a number of measures are being taken in our country to ensure food security and increase the welfare of our population. Accordingly, a number of measures are being taken to establish almond, pistachio and walnut groves in the forestry of the republic.

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Due to the fact that the climatic conditions of the Republic of Uzbekistan are favorable for the reproduction and spread of diseases and pests that damage ordinary walnut trees, it is important to develop resource-efficient methods of protection against diseases and pests in the newly established walnut plantations [1, 9-11]. It is also important to develop immediate measures to prevent the spread and damage to new species of quarantine objects, which are likely to be found in imported seedlings, and their spread and damage to ordinary walnut trees growing in the wild in the country. Moreover, a number of measures are being taken to organize the cultivation of almonds in the forests of the country, so it is important to study the species composition, biological and ecological characteristics of almonds, which occur at different stages of development and damage [2, 3, 14].

Almond belongs to the family of walnut fruits and is one of the most widely cultivated trees in the country. Further strengthening of food security of the country, expansion of production of environmentally friendly products, significant increase in the export potential of the agricultural sector are important, and ensuring food security is one of the priorities. Almonds (*Amygdalus cammunis* L.) are trees and shrubs belonging to the genus *Amygdalus* [2, 3, 6]. About 40 species of almonds are known today, and it is distributed in North Asia and Central America, southern Europe, Central Asia. There are 5 species in Uzbekistan, mainly sweet almond (*A.comminis* L.), the rest are found in the wild. It is grown in the mountainous areas of Uzbekistan (Fergana Valley, Surkhandarya, Samarkand, Tashkent regions) at an altitude of 1000-1200 m above sea level. The fruit is a hard-shelled kernel (walnut) covered with pust (cracks when ripe) and ripens in July and September. Magnesium contains 35-67% fat, up to 30% protein, as well as sugar, glue (bitter almond contains up to 2.5% amygdalin). Depending on the navigation, the shell is thin (smooth), medium and hard, the core is sweet or bitter. Of great economic importance, almonds are grown mainly for sweet core [1, 3, 10]. In order to obtain high-quality and high-quality almond trees in the forests from early spring to early ripening, it is necessary to determine a variety of pests that damage the plant and its crops in the climatic conditions of the country, and the species composition, distribution, damage period and degree of damage. With this, it is possible is to develop and implement a harmonized control system of the almond pests with high biological and economic efficiency.

It is stated that there are 20 main pest species of almonds, including semi-hard wings (candelabra)-3 species belonging to the category of *Hemiptera*, *Equatorial* (juices) – 3 species belonging to the category of *Homoptera*, hardwoods (beetles)-6 species belonging to the category of *Coleoptera*, *Tangerines* (butterflies)–5 species belonging to the category of *Lepidoptera* [4, 9-10]. Additionally, there are also a number of other diseases and pests of almond and walnut fruit trees, which are aphids, moths, fruit trees, and a number of other pests. Although a number of pests are found in almond trees, it has been noted that the dominant type of these pests is walnut berry [15].

The main pest of almonds in Uzbekistan is *Erschoviella musculana* Ersch., Pests belonging to the genus *Cymbidae* family, which reduced almond and walnut yields by 40-50%, and even it was 80% in some areas of the country [8-11]. Therefore, it is very urgent to study the species composition of almond pests in forest agrobiocenosis, the biological and ecological characteristics of pests of these crops, their distribution, and degree of damage and control measures in the conditions of Uzbekistan. This research was intended to investigate species composition, bioecological features, damage and methods of control of almond pests in forests.

2 Materials and methods

The research was conducted in forestry farms of Fergana region. The influence of natural climatic conditions on the development of pests is important, so the climatic conditions of

this region were also studied. The Fergana Valley is located on a low plateau surrounded by mountains on three sides and borders Kyrgyzstan and Tajikistan. Fergana region is located in a biologically active region with a total area of 424 thousand km², and climate condition is very stable. Summers are long and hot, and winters are cold. The average annual temperature goes up to 28°C. In July, the temperature rises to 39 °C, from which an increase was also observed. In 310-320 days of the year, the air temperature is above 0 °C and in 180-200 days, it is above 10 °C. Hot weather and dry air quickly reduce soil moisture [2-3, 6]. The lowlands are surrounded by hills in the direction of the mountains and have a unique landscape. This relatively small, intermittent region varies greatly from soil to climate, fauna and flora as it moves from lowland to mountain. Much of the soil consists of meadow, hungry, and the same gray soils. This is why soil erosion occurs here and the surface part of the soil can move.

The effect of temperature on insect development was studied in special thermostats with constant humidity of 65-70%. The biological efficacy of chemicals was calculated according to the formula of W.S. Abbot (1925) [16]. The organization of pest protection works depended on the number of pests, the amount of wood or the amount of leaves that the worm loses during its life. This was calculated using the formula proposed by A.I. Ilinsky (1965):

$$U_2 = (100 \cdot H/L)/K,$$

here:

U_2 - degree of danger or the amount of needle leaves that can be lost in model trees, in percentage;

K - the number of leaves or foliage present in model trees.

N - the amount of needle leaves or leaves needed to feed the juice worm during its life, kg;

L - the number of detected pest eggs or worms on a model tree or twig, pcs.

In deciduous trees, pest control can be done when 30 percent or more of the tree's leaves are at risk of extinction. It is recommended that chemical treatment of trees against pests can be carried out standing on ground when trees are on average of 4-8 meters, whereas it can be done using single-legged aggregates for trees with 12 meters height. Tall trees can be treated using aero aggregates, such as helicopters and aerosol generators).

A №300 microscope was used to identify pest and entomophagous species. Pest species, bioecology, dominant distribution, and damage caused were studied [2, 15]. Temporary drugs are made from live insects. To do this, Hoer liquid (*Berleza liquid*) is applied to the subject glass (dripped, insecticide is placed on it, and a closed glass is placed and heated until it shines. However, the drug is not suitable for long storage [8]. Intended for long-term storage, permanent preparations use Canadian or pixa balm as a preservative for this purpose. There are two ways to prepare these drugs. The second method was used for our research. Insect identification is carried out on days 1, 3, 7 and 14 before and after spraying. The biological efficacy of chemicals was calculated using the formula of W. S. Abbot [1].

$$E = \frac{A_v - V_a}{A_v} \times 100,$$

here: E - biological efficiency, %;

A - the number of pests in the experiment before spraying;

a - the number of pests in the experiment after spraying;

V - the number of pests in the control variant before spraying;

v - the number of pests in the control variant after spraying [2, 3].

When cultivating trees 3-5 meters tall, 500-600 liters of working fluid per hectare is used. The effectiveness of the drugs is calculated by the amount of damage between the spilled almonds.

Chemical treatments were performed in three replicates, in three trees, with each test drug. Chemical treatment was carried out 3 times during the growing season when the trees sprouted buds, flowering phase and 14 days after the 2nd treatment at the rate of 1000 l/ha of working solution (Table 1).

Table 1. Experimental options against walnut pests (Fergana region, Fergana forestry, Uzbekistan).

#	Experimental variants	Application rate, l or kg/ha
1.	Control (<i>chemically untreated</i>)	-
2.	Avaunt, 15 % em.k.(sample)	0.5
3.	Mospilan, 20% n.kuk.,	0.4

3 Results and discussion

Observations on the distribution of pests in the Fergana region in 2018-2020 revealed that although almond agrobiocenosis killed more than 10 species of pests, and the predominant pests among the killed pests were walnut moth, small walnut aphids and large walnut aphids. The results showed that pests belonging to the family Lepidoptera could seriously damage the fruits, leaves and twigs of almonds.

Walnut moth - *Erschoviella musculana* Ersch. A family of moths (*Lepidoptera*), belongs to the family of nightshades (*Symatophoridae*) and is a common pest in all regions of Central Asia [1, 10-13]. This type of pest is endemic to Central Asian countries and is found in all regions where almonds and walnuts grow. The size of a mature insect-butterfly is 8-11 mm, with wingspan 16-25 mm. The length of the mature worm is up to 16 mm, the color is dark or greenish-brown. The head, anterior chest, and anal shields are brown. The whole body is covered with brown, hairy warts. Almonds are usually damaged by 20-30% of this fruit, and in some years by 60-80%. Fruit damage is of two types; in young fruits that have not hardened the seeds, the fruit sheds because of the worm eating the center of the nucleus. In stale fruits, the worm feeds only on the side of the fruit, eating all of its flesh and leaving only the outer peel, resulting in the fruit completely darkening or forming dark brown streaks and spots on it. Pests of 2-3 generations of the pest overwinter in tree cracks.

According to the results of the study, in 2018-2020, 28 species of entomophagous species belonging to 10 families of five genera of the genus *Erschoviella musculana* Ersch were found in the conditions of Fergana region. It was compiled based on the sources studied according to the systematic analysis of entomophages. Accordingly, entomophages feeding on different stages of development of the nut fruit were divided into specialized and co-species. In addition, the agrobiocenosis of the studied area revealed higher levels of parasites than predatory and parasitic entomophagous. According to the families of homophages identified, encountered families of *Braconidae*, *Trichogrammatidae*, *Ichneumonidae*, *Chalcidoidae*, *Pteromalidae*, *Encyrtidae*, *Tachinidae*, *Coccinellidae*, *Chrysopidae*, *Miridae*, *Microgaster nemorum* Hrtg as species entering the family of *Braconidae* from them., *Microdus rufipes* Nees., *Macrocentrus delicatus* Cress., *Ascogaster quadridentatus*. *Trichogramma Embryophagum* Htg as representatives of the *Trichogrammatidae* family., *Trichogram evanescens* Gir. *Diadegma armillata* Grav, as well as representatives of the family of *Ichneumonidae*, the most frequent flyer, *Scambus*

brevicornis Grav., *Mastrus deminuens* Hartig., *Pimpla torianellae* Lin., *Pimpla inquisitor* Scop., *Liotrifone punctulatus* species were recorded.

Elasmus albipennis Thomson of the *Chalcidoidea* family, *Dibrachys cavus* Walk of *Pteromalidae* family, types were recorded as well as the least observed species. These species were involved in parasitic boss relations in the management of the amount of pests worms and buds in relatively rare cases. The possibility of multiplying and applying these types of deposits was found out. Furthermore, one parasite from the *Encyrtidae* family was identified. The family *Agéniaspis Tachinidae* was also important in pest control, including *Dexia rustica* F., *Tiphia femorata* F., *Scolia hirta*., *Lydella nigripes* Fall. Representatives of the *Coccinellidae* family, species *Adalia bipunctata* Lin., *Adonia variegata* Gz., *Exochomus flavipes* Thurb, *Coccinella punctata* Lin., *Coccinella septempunctata* Lin., as hardy species was played a significant role in reducing the number of relatively common foliage in horticulture. *Chrysopa carnea* Step., and *Chrysopa septempunctata* Wegm from the family *Chrysopidae* as another wild entomophagy, which was listed as the most common omnivorous entomophagous.

The main pest of almonds in forests was *Avaunt*, 15% e.k., from chemicals against walnuts. In the variant of application of the drug at the rate of 0.5 kg per hectare, the average amount of fruit on an almond tree was 525.6 pieces, of which 66.2 pieces were shed during the season. Of these, the number of fruits infested with nuts was 16.4, while the number of mechanically damaged fruits (from wind, various diseases) was 49.2. Healthy fruits accounted for 87.5% of the total harvest during the season.

When *Mospilan* with 20% n.kuk., was applied at 0.4 l/ha in the variant, the average number of fruits per bush at the beginning of the season was 502.7, of which the fruits shed during the season were observed. 77.7 pieces fruits were naturally shed, 22.4 pieces was shed by harm of walnut moth, and 36.3 pieces were mechanically damaged. The volume of healthy fruits was 82.3% of the total harvest. In the control variant, it was found that at the beginning of the season there were 576.2 almonds in one bush, while 369.9 berries were shed during the season, and 272.3 berries was shed due to walnut moth. In addition, the number of mechanically damaged fruits from spilled fruits was on averaged 97.6 pieces and the share of healthy, tolerant fruits in the total harvest was 35.8% (Table 2).

Table 2. Biological effectiveness of insecticides against almonds in almonds (Fergana region, Fergana forestry 2018-2020).

#	Experimental variants	The amount of drug, l/ha	The average number of fruits per tree, pcs			Damaged fruit %			Decrease in damage compared to control %	
			Shed	Harvest		Shred	Harvest		Manually harvested	Total
				Taken	Total		Manually harvested	Total		
1	<i>Avaunt</i> , 15 % em.k.(sample)	0.5	66.2	459.4	525.6	16.4	3.2	19.5	76.4	87.5
2	<i>Mospilan</i> , 20% n.kuk.,	0.4	77.7	502.7	580.4	22.4	2.5	24.9	90.4	82.3
3	Control	-	369.9	206.3	576.2	272.3	26.1	298.4	-	-

4 Conclusions

According to the results of the study, in 2018-2020, 28 species of entomophagous species belonging to 10 families of five genera of the genus *Erschoviella musculana* Ersch were found in the conditions of Fergana region. It was compiled based on the sources studied according to the systematic analysis of entomophages. Accordingly, entomophages feeding on different stages of development of the nut fruit were divided into specialized and co-species. In addition, the agrobiocenosis of the studied area revealed higher levels of parasites than predatory and parasitic entomophagous.

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