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Types, Development And Entomophages Of Plant Lice In Vegetable And Cucurbits Crops In The Condition Of Karakalpakstan

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ABSTRACT

The article discusses the types of aphids that develop on vegetable and cucurbits crops in the conditions of Karakalpakstan, their bioecological development characteristics, the crops affected by each aphid species, and their damage. It also lists the predators and parasites that contribute to reducing the population of these pests. Additionally, the article provides scientific information on the importance of preventive methods against aphids.

Keywords: *agrocenosis, station, aphid, plant lice, entomophage, predator, parasite, economic damage threshold (EDT), biological method, morphology, bioecology.*

1. INTRODUCTION

Vegetable and cucurbits crops grown by our farmers play an essential role in providing food for the population. It is no secret that food security and the cultivation of ecologically clean products are becoming significant issues worldwide. Therefore, modernization and diversification of the economy, especially in agriculture, with particular attention to food crop cultivation, is a priority.

In this regard, over the past four years, 300,000 hectares of low-yield cotton and grain fields have been converted to fruit, vegetable, and other food crops, including the establishment of 32,000 hectares of intensive orchards, 15,000 hectares of vineyards, 2,000 hectares of modern greenhouses, 114,000 hectares for vegetables and potatoes, 72,000 hectares for legumes and oil crops, and 52,000 hectares for other food crops.

A pressing issue that has long concerned our farmers and producers is the preservation of harvested fruits and vegetables, ensuring quality processing, and delivering them to domestic and international markets without waste. Thus, one of the primary goals in raising the economic standing of farms in our country is to supply the population with vegetable and melon products during summer and winter months, while also exporting a portion of the products.

Currently, farmers across the Republic cultivate 15-20 thousand hectares of vegetables and cucurbits crops, yielding 30-40 centners of produce per hectare. However, this is 2.5 to 3 times less than expected.

According to medical recommendations, for the normal development of the human body throughout the year, each person in the Republic should consume an average of 113.0 kg of vegetables and 50.4 kg of melon products, or an average of 81.7 kg per person annually. However, the current consumption rate is about 44.4 kg per person. The main reasons for this are poor meliorative conditions of farmland, increasing soil salinization, and the harmful effects of agricultural pests, diseases, and weeds. Therefore, to improve the productivity of vegetables and cucurbits crops, it is necessary to improve the meliorative condition of the soil, reduce salinity, and develop effective methods to control plant pests.

According to well-known scientists in Uzbekistan such as E.Sh. Toreniyazov (2013; 2014) and Sh.T. Khojaev (2015), the melon aphid (Aphis gossypii Glov.) causes significant damage to melon, cucumber, and tomato crops, while the cabbage aphid (Brevicoryne brassicae L.) severely harms cabbage crops. Despite the implementation of modern agro-technical measures to control pests in agricultural crops, research shows that 30-40% of vegetable and cucurbits crops are lost each year.

According to well-known scientists in Karakalpakstan, two main factors contribute to soil salinization: excessive irrigation leading to the rise of groundwater and the subsequent evaporation of water, leaving salts in the soil; and the deposition of salt particles (30-75 million tons annually) carried by dust from the exposed bed of the Aral Sea onto agricultural lands, exacerbating soil salinization (Baxiyev, 1992; Smetov, Babaniyazov, Abillayev, 1992).

To solve these problems, prevent the loss of harvested products, and provide the population with ecologically clean vegetables and melons, it is essential to study the specific environmental conditions and bioecological characteristics of pests, develop effective pest control methods, and ensure that the applied methods achieve more than 98% biological effectiveness.

Thus, based on the results of scientific research, information on the predominant types of aphids and entomophages in vegetable and cucurbits crops, their morphology, bioecological development characteristics, economic damage threshold, and the biological, agro-technical, chemical, and preventive control methods were introduced.

2. METHODS OF THE EXPERIMENT

The experiments to identify aphid species, study their bioecological development, and test control methods in vegetable and cucurbits crops were conducted at the Agro-toxicology Laboratory of the Scientific Research Institute for Plant Protection of Uzbekistan (SRIPPUz) and the Plant Protection and Quarantine Laboratory at the Karakalpakstan Institute of Agriculture and Agrotechnologies (KKIAA).

Lysimetric monitoring was carried out on the institute's experimental plots. Field experiments were conducted at the institute’s experimental farm (Nukus district) and in the fields of the "Baxtli" farm in Chimbay district, as well as at the specialized vegetable and melon farms "Kattagar" and "Darson" in Nukus district.

Chemical analyses were performed in the Agro-toxicology Laboratory of SRIPPUz, the Karakalpakstan State Nature Protection Department Laboratory, and the General Analyses Laboratory at the Karakalpakstan Institute of Agriculture and Agrotechnologies.

The object of the experiment was the species of aphids and entomophages developing on melon, pumpkin, cucumber, tomato, cabbage, and other vegetable and cucurbits crops.

To study the density of aphid and entomophage species in the field on vegetable and cucurbits crops, route-based monitoring was conducted. The population of aphid species in each station was assessed every 8-10 days. This was done using the method outlined by F.M. Uspenskiy [1973], where in each station, 100 plants (20 samples of 5 plants each) were examined along the diagonal of the field to identify the pest species present.

The number of entomophages was determined based on the methodological guidelines prepared by V.A. Shapiro and V.A. Shepetilnikova [1976] titled "Recording entomophages of pests in agricultural crops." The data was recorded in a field journal.

The damage level caused by aphids in each station (melon, cucumber, tomato) was studied using entomological cages made of gauze, measuring 1 m², and in open field conditions with three repetitions, following the method of V.I. Tanskiy (1981).

Agro-toxicological experiments were conducted in the laboratory, in small-plot trials, and in large-scale production field trials. The use of chemical preparations against pests and the subsequent recording of pest numbers, as well as the effectiveness and biological utility of the preparations, followed the method of A.K. Gar (1963).

In small-plot field trials, the application of pest control preparations was done using handheld sprayers, while in large-scale field trials, the OVX-28 tractor-mounted sprayer was used, mixing 300-400 liters of water per hectare with the preparation.

The size of the small-plot trial area was 100 m², while the production-scale field trial covered 5 hectares, with three repetitions.

Before the application of the preparation, the pest population in the field was recorded, and after application, the number of surviving aphids was counted on the 1st, 3rd, 7th, and 14th days. Based on the data obtained regarding the biological efficacy of the preparations, the effectiveness over time was calculated using the Abbot formula (1925), as follows:

$$\text{Effic.} = \frac{Ab - Ba}{Ab} \cdot 100,$$

In this case:

- Effic. - biological efficacy, in %;
- A - the number of pests in the experiment before the application of the preparation;
- a - the number of pests in the experiment after the application of the preparation;
- B - the number of pests in the control variant before the application of the preparation;
- b - the number of pests in the control variant after the application of the preparation.

3. RESULTS OF THE EXPERIMENT

Species composition, morphology, bioecology, and damaging plants of aphids

In the implementation of consistent pest control measures for agricultural crops, it is essential to identify the species composition of pests in the crops, their morphology, biological and ecological developmental stages, as well as the density of each pest species on plants during their vegetative period, in relation to their spread across crops.

As a result of the conducted experiments, it was determined that several species of aphids spread in vegetable and cucurbits crops in the conditions of Karakalpakstan. In any region, dangerous pests develop, adapting to the natural climate conditions of their respective biotopes. For this reason, the types of aphids found in vegetable and cucurbits crops in the area were identified. During directed monitoring, the species of aphids were collected from vegetable and cucurbits crops and identified with the help of systematic scientists from the Institute of Zoology and Parasitology of the Academy of Sciences of the Republic of Uzbekistan. As a result, it was found that five species of aphids develop during the vegetative periods of vegetables and cucurbits crops cultivated on the farms of our Republic. Among them were melon aphid (Aphis gossypii Glov.), cowpea aphid (Aphis craccivora Koch.), cotton aphid (Acyrthosiphon gossypii Mordv.), mealy plum aphid (Hyalopterus pruni F.), and cabbage aphid (Brevicoryne brassicae L.) (Table 1).

Among the five identified aphid species, it was noted that the melon and cowpea aphids (both in open and closed areas) were found on all types of vegetable and cucurbits crops, but they massively developed on cucumber, melon, and pumpkin crops, while they appeared in smaller quantities on other crops.

The cotton aphid appeared in small quantities on crops and did not form large colonies.

The mealy plum aphid was found on apricot trees in orchards, and during the period when melon, cucumber, and pumpkin crops, which were planted between the rows of the orchard, produced 5-6 leaves, the aphids formed columns like ants, descending from the fruit trees and spreading onto the crops, causing significant damage. Especially plants located close to the fruit trees were severely affected, sometimes leading to their death.

The cabbage aphid was found only on cabbage and caused significant damage, while the melon and cowpea aphids were the main pests on melon, pumpkin, and cucumber crops.

Table 1. Types of aphids damaging vegetable and cucurbits crops in Karakalpakstan and their extent of damage

№	Type of crop	Types of aphids and density				
		Melon aphid (Aphis gossypii Glov.)	Cowpea aphid (Aphis craccivora Koch.)	Cotton aphid (Acyrthosiphon gossypii Mordv.)	Mealy plum aphid (Hyalopterus pruni F.)	Cabbage aphid (Brevicoryne brassicae L.)
1	Melon	+ + +	+ + +	-	+	-
2	Pumpkin	+ + +	+ +	-	+	-
3	Watermelon	+ +	+	-	+	-
4	Cucumber	+ + +	+ + +	-	+ +	-
5	Tomato	+ +	+	+	+	-
6	Eggplant	+ +	+	-	-	-
7	Pepper	+ +	+	-	+	-
8	Dill	+ + +	-	-	+	-
9	Cabbage	-	-	-	-	+ + +

Note: + - low pest occurrence; ++ - medium pest occurrence; +++ - high pest occurrence; - no pests found

Melon and cowpea aphids were found to develop massively on cucumber, melon, and pumpkin; they occurred in moderate amounts on watermelon, tomato, eggplant, pepper, and dill. The mealy plum aphid was observed to heavily infest the vegetable and melon crops located close to apricot trees, specifically cucumber, melon, watermelon, and pumpkin, causing significant damage. The cotton aphid appeared on all crop types from the beginning to the end of the vegetative period, but its average number per plant was 0.5-1.0 individuals, and it did not form colonies. The cabbage aphid was found only on cabbage crops, with the number of aphids on affected plants exceeding 1,000.

Based on the scientific data presented above, it was determined that the dominant aphid species on vegetable and cucurbits crops were the melon aphid, cowpea aphid, mealy plum aphid, and cabbage aphid, with the melon and acacia aphids being identified as particularly dangerous pests.

For effective control measures against dangerous aphid species in vegetable and cucurbits crops, it is necessary to determine the average number of pests per plant or leaf in the field. Therefore, in the next experiment, route monitoring was conducted in the farms of Chimbay, Nukus, and Kegeyli districts, which are considered the northern districts of our Republic, to identify the dynamics of aphid development. During this monitoring, the time of aphid emergence and their development on wild grasses growing along the edges of fields and near irrigation ditches, as well as the transfer of aphids from wild grasses to cultivated crops, were studied.

As a result of the monitoring, it was found that in the northern districts of Karakalpakstan, aphids begin to emerge from their overwintering sites in the second and third ten-day periods of April, depending on air temperature, i.e., when the average daily air temperature consistently rises above 10-12°C for 2-3 days. The aphids that emerge from overwintering sites move to the first sprouting wild grasses around the field, and their first generation develops on these plants. When field crops start sprouting and seedlings emerge, the pests move to these crops, where their subsequent development continues on the cultivated plants.

To clarify this process, a scientific experiment was conducted from 1992 to 1995 to identify the development of aphids after they emerged from overwintering sites. The monitoring results showed that after aphids emerge from overwintering, melon aphids and cotton aphids develop on the early spring sprouting plants of couch grass, burdock, and watercress growing along fields and ditches in the first and second ten-day periods of April, while cowpea aphids develop on camelthorn and licorice plants, and cabbage aphids develop on second-year cabbage left in the field. The mealy plum aphid was found to develop on the newly sprouting shoots of apricot trees.

By the second and third ten-day periods of May, aphids massively developed on wild grasses. Once the seedlings of vegetable and cucurbits crops sprouted in the field, aphid pistils in these groups produced wings and flew to the young seedlings, where they spread live-born larvae and continued their summer development on vegetable and cucurbits crops.

From the third ten-day period of May until the end of June, melon and cowpea aphids developed on cucumber, melon, and pumpkin crops, the mealy plum aphid developed on vegetable and cucurbits crops planted between fruit trees in orchards, cabbage aphids developed on cabbage, causing significant damage, and cotton aphids developed in small numbers on tomato.

During the experiment, the development dynamics of melon aphid (Table 2), cowpea aphid (Table 3), and cabbage aphid (Table 4) on vegetable and cucurbits crops were studied.

Table 2 data reveals that during the vegetation period, melon aphids developed on melon, watermelon, pumpkin, cucumber, tomato, eggplant, and dill crops, with the most significant increase observed on melon and cucumber crops. The average number of aphids per plant in June reached 44-88 on melons, and by the end of September and October, this number increased to 56-84 aphids per plant. In pumpkins, the numbers ranged between 28-42 in June and 28-62 by September-October, while on cucumbers, the numbers were 54-92 and 79-98 aphids per plant, respectively.

Table 2.

Development dynamics of melon aphid

№	**Type of crop**	**The average amount of the pest on 1 plant, piece**																				
		May			**June**			**July**			**August**			**September**			**October**			**November**		
		I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
1	**Melon**	**2**	**8**	**19**	**44**	**88**	**45**	**12**	**3**	**3**	**2**	**2**	**2**	**6**	**22**	**56**	**84**	**80**	**48**	**18**	**0**	**0**
2	Watermelon	0	0	1	3	7	12	4	2	1	0	0	0	0	3	5	14	22	18	6	0	0
3	**Pumpkin**	**1**	**5**	**12**	**28**	**42**	**34**	**8**	**4**	**2**	**1**	**0**	**0**	**2**	**9**	**28**	**62**	**58**	**43**	**10**	**0**	**0**
4	**Cucumber**	**5**	**17**	**31**	**54**	**92**	**90**	**27**	**19**	**8**	**4**	**3**	**3**	**7**	**36**	**79**	**98**	**91**	**52**	**21**	**0**	**0**
5	Tomato	0	0	3	7	12	21	6	2	2	1	1	1	3	9	22	36	31	14	5	0	0
6	Eggplant	0	1	1	4	9	26	14	3	2	0	0	0	2	8	21	34	26	9	2	0	0
7	Pepper	0	0	3	8	15	28	16	4	2	1	0	1	3	9	26	38	24	7	2	0	0
8	Dill	0	2	5	12	29	37	18	3	2	2	1	1	4	12	28	41	26	14	5	0	0

The pest number decreased during July and August due to rising temperatures but rebounded as temperatures normalized in September. Starting from the second ten-day period of November, the pests began migrating to overwintering sites.

From this, it is clear that melon aphids are particularly dangerous for melon, cucumber, and pumpkin crops, especially during the young seedling stage in June and the late part of September and early October, when they multiply massively and cause damage to the plants. After nourishment, the aphids move to overwintering.

Table 3 shows the development of cowpea aphids on melon, pumpkin, cucumber, and eggplant crops. Their average number per plant during June, September, and October increased to 40-76 on melon, 38-54 on pumpkin, 49-86 on cucumber, and from 26 to 40 aphids on eggplant. Hence, cowpea aphids also accumulate on crops during their young seedling stages and the end of the vegetation period, causing significant damage. During this time, the aphids prepare for overwintering.

Table 4 shows the development of cabbage aphids on cabbage crops. This development begins in the first ten-day period of May and continues until the end of the vegetation period, with late cabbages being particularly affected. Monitoring showed that the massive development of the pest occurred in June, with the average number of aphids per plant increasing from 40 to 68. The aphid population decreased in July and August but increased again to an average of 48 per plant in the third ten-day period of September and 76 in October.

The mealy plum aphid was found to develop on apricot trees, migrating to all types of vegetable and melon crops planted between fruit trees.

Table 3. Development dynamics of cowpea aphid

№	**Type of crop**	**The average amount of the pest on 1 plant, piece**																				
		May			**June**			**July**			**August**			**September**			**October**			**November**		
		I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
1	**Melon**	**2**	**6**	**17**	**40**	**68**	**41**	**9**	**2**	**2**	**2**	**2**	**2**	**4**	**19**	**48**	**76**	**71**	**37**	**9**	**0**	**0**
2	**Pumpkin**	**1**	**3**	**8**	**24**	**38**	**28**	**6**	**2**	**2**	**1**	**0**	**0**	**1**	**7**	**23**	**54**	**50**	**35**	**8**	**0**	**0**
3	**Cucumber**	**4**	**14**	**28**	**49**	**86**	**72**	**22**	**14**	**6**	**3**	**2**	**2**	**4**	**31**	**72**	**84**	**73**	**34**	**9**	**0**	**0**
4	Eggplant	0	1	1	6	14	26	12	3	2	1	0	1	3	9	28	40	26	6	2	0	0

Table 4. Development dynamics of cabbage aphid

№	**Type of crop**	**The average amount of the pest on 1 plant, piece**																				
		May			**June**			**July**			**August**			**September**			**October**			**November**		
		I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
1	Cabbage	2	6	17	40	68	41	9	2	2	2	2	2	4	19	48	76	71	37	9	0	0

During this migration, not only did winged adults move, but the larvae, like ants, were observed moving down from the fruit trees and onto the plants. During the peak infestation period of May-June, the average number of aphids per plant reached 250-300, causing the plants to perish completely.

Across all crop types, a decrease in the average number of aphids per plant was observed from July to the end of August. The reason for this decline was daytime air temperatures rising above 45°C and a drop in humidity, which reduced the pest population to its minimum.

Thus, the scientific data presented shows that five types of aphids develop on vegetable and melon crops in the agricultural conditions of Karakalpakstan, with three types being dominant. The peak periods for damage caused by these dominant aphid species are May-June and September-October, while the majority of the pest population enters a summer diapause in July-August.

In addition, during the experiment, the species composition, density on plants, and bioecological development conditions of natural entomophages in the aphid groups on agricultural crops were monitored.

As a result of the observations, the development of several types of natural entomophages in aphid groups was identified. Among the reviewed entomophages, predatory and parasitic species were recorded (Table 5). Among the predators, 2, 7, and 14-spotted ladybird beetles and their larvae, the adults and larvae of common lacewings, syrphid fly larvae, and predatory mite larvae were observed.

Among the parasitic entomophages, the development of aphidiids was identified. From the table, it can be seen that adult ladybird beetles and their larvae frequently appeared in aphid clusters, feeding on the aphids. During the spring, at the young seedling stage of the plants, one predator was observed per three plants. These predators participated in reducing the pest population until late autumn.

Syrphid fly larvae, which are specific entomophages of aphids, were found in moderate numbers in aphid groups, feeding exclusively on aphids. Predatory mite larvae, observed in small numbers, attached to the body and wings of aphids and fed by consuming them.

Table 5 Types of natural predatory and parasitic entomophages on vegetable and melon crops

№	Name of the entomophage	The period of nourishment	The amount of occurrence
Predatory entomophages			
1	Ladybird	Beetles, larvas	+ + +
2	Syrphid fly	Larvas	+ +
3	Predatory mite	Imago, larvas	+
4	Lacewing	Larvas	+ + +
Parasite entomophages			
3	Aphidiid	Imago, larvas	+ +

Note: + - rarely observed; ++ - moderately observed; +++ - frequently observed

The harmfulness of aphid species on vegetable and cucurbits crops

Scientific experiments revealed that harmful aphid species develop on several types of vegetable and cucurbits crops, causing significant damage. Among them, melon and cowpea aphids simultaneously infest and develop on cucumber, tomato, eggplant, pepper, melon, and pumpkin crops, severely damaging them.

In studying the harmfulness levels of aphids, we reviewed the scientific work of previous researchers. For instance, according to P.I. Leontyan (1978), in Moldovan conditions, the harmfulness level of pests was studied based on their density on plants, and the level of harm was determined using a point system. That is, when pest density corresponded to 1 point, 24% of the crop was lost.

In Uzbekistan, S.N.Alimukhamedov (1979) conducted many years of research and found that if protective measures against aphids were not taken during the vegetation period, 20-30% of the crop could be lost.

In the conditions of Karakalpakstan, the harmfulness level of aphid species on vegetable and cucurbits crops had not been determined, and as a result, the economic damage threshold had not been established. In this field, research was only conducted on cotton crops by G.Sh.Shamuratov (1979) and G.Sh.Shamuratov and A.J.Jumaboyev (1991). They determined that if 11-50 aphids were found on 25% of cotton plant leaves, and if entomophages were absent, it was considered the economic damage threshold. However, the economic damage threshold for aphid species on vegetable and cucurbits crops had not been determined.

Therefore, scientific experiments were conducted to study the damage caused by aphids during different growth stages of melon, cucumber, and tomato plants.

In the first year of the experiment, lysimeters were used. Each lysimeter measured 1 m². A single plant was grown in each lysimeter, which was covered with entomological cages made from gauze material. In these cages, during different development phases of the plant (3-4 true leaves, budding, flowering, and fruiting), 5, 10, 15, and 20 melon aphids were introduced, and the development of the pest was observed. The main purpose of covering the lysimeters with entomological cages was to protect the aphids from natural entomophages. As a result, the pest could develop normally, allowing the harmfulness level to be determined. In the control variant, no pests were introduced. The experiment was conducted with four repetitions (Table 6).

Table 6 The harmfulness of melon aphids on vegetable and melon crops depending on the infestation time (in entomological cages)

Variants	The weight of average 1 plant, kg	Product of average 1 plant, kg	Destroyed product on 1 plant	
			kg	%
In the period of making 5-6 true leaves of the plant				
Melon	0	0	5,7	100
Control	2,5	5,7	0	0

Cucumber	0	0	2,3	100
Control	0,14	2,3	0	0
Tomato	0,04	1,3	0,3	18,7
Control	0,05	1,6	0	0
In the period of budding of the plant				
Melon	1,5	2,4	2,4	50
Control	2,4	4,8	0	0
Cucumber	0,08	1,4	0,7	33,3
Control	0,12	2,1	0	0
Tomato	0,05	1,5	0,2	11,7
Control	0,07	1,7	0	0
In the period of fruiting of the plant				
Melon	1,8	3,6	1,4	18,0
Control	2,5	5,0	0	0
Cucumber	0,09	1,9	0,5	10,8
Control	0,13	2,4	0	0
Tomato	0,07	1,7	0,1	5,5
Control	0,08	1,8	0	0

The second experiment was conducted in open fields, where measures were taken to prevent the natural infestation of plants by aphids. If a small number of aphids appeared, they were removed manually; when a large number appeared, they were controlled with the insecticide Karate at a rate of 0.2 liters per hectare.

During the plant's 5-6 leaf stage, budding, and fruiting phases, 50 aphids were distributed on each plant.

As shown in the table, when 50 aphids infested a melon and cucumber plant during the 5-6 true leaf stage, and no control measures were taken, 100% of the crop was lost, whereas in tomato crops, 18.7% of the crop was lost.

During the budding phase, comparative losses of 50.0%, 33.3%, and 11.7% were observed in melon, cucumber, and tomato crops, respectively. During the fruiting phase, 18.0%, 10.8%, and 5.5% crop losses were recorded.

Thus, when melon and cucumber plants are infested with aphids during the young seedling stage in early spring, the favorable environmental temperature for aphid development and the vulnerability of young plants lead to rapid pest growth. The pests cover the growing buds and leaves completely, causing severe damage. As a result, the plants die completely at a 100% rate.

In our open field experiment, the level of damage caused by melon aphids was lower compared to the data from the experiments conducted in entomological cages. This is because, in open fields, the interaction between pests and natural entomophages, especially ladybugs, syrphid fly larvae, and lacewing predators, reduced the number of pests, thus decreasing the level of damage. The results of the experiment are presented in Table 7.

As shown in the table, during the 5-6 true leaf stage of the plants, the level of damage caused by the pests reached 100%. This indicates that during the young seedling stage, plants are more susceptible to pests due to their short height and fewer leaves.

During the budding phase, 44.6% of the crop was lost in melons, 28.5% in cucumbers, and 5.5% in tomatoes.

During the fruiting phase, the plants were taller, had more leaves, and were nearing the end of their growth cycle, which reduced the pests' harmfulness.

In other words, melon plants were damaged by 10.0%, cucumbers by 9.0%, and tomato plants by 5.2%.

Table 7 The harmfulness of melon aphids on vegetable and cucurbits crops depending on the infestation time (in open fields)

Variants	The weight of average 1 plant, kg	Product of average 1 plant, kg	Destroyed product on 1 plant	
			kg	%
In the period of making 5-6 true leaves of the plant				
Melon	0	0	7,0	100
Control	3,5	7,0	0	0
Cucumber	0	0	2,5	100
Control	0,18	2,5	0	0
Tomato	0,07	1,6	0,3	11,0
Control	0,08	1,8	0	0
In the period of budding of the plant				
Melon	1,8	3,6	2,9	44,6
Control	3,2	6,5	0	0
Cucumber	0,08	1,5	0,6	28,5
Control	0,13	2,1	0	0
Tomato	0,08	1,7	0,1	5,5
Control	0,07	1,8	0	0
In the period of fruiting of the plant				
Melon	2,7	5,4	0,6	10,0
Control	3,0	6,0	0	0
Cucumber	0,12	2,0	0,2	9,0
Control	0,14	2,2	0	0
Tomato	0,07	1,8	0,1	5,2
Control	0,08	1,9	0	0

In natural conditions, when aphids infested the plants during the budding phase, 5% more yield was obtained compared to the variant enclosed with entomological cages. During the fruiting phase, the yield increase was 10%. This improvement is due to the participation of natural predators (entomophages). In our open-field experiment, the entomophages that played a role in controlling aphids included ladybird beetles and their larvae, syrphid fly larvae, and lacewing larvae, with an average of 2-3 predators observed per aphid colony on each infested leaf.

The results of our experiment clearly indicate that the earlier the aphids infest the plants, the more dangerous it is, whereas later infestation, such as during the fruiting phase, causes less damage compared to earlier phases.

During our scientific experiment, we determined the economic damage threshold of the pests using the methodology of V.I. Tanskiy (1981), which allows for a 3% loss margin. The economic damage threshold (EDT) of high-yield crops was calculated based on the following formula:

$$EDT \quad \frac{X \cdot Ч}{33{,}3 \cdot C};$$

Where:

- EDT – Economic damage threshold;

- X – Number of pests eliminated;

- 33.3 – Coefficient corresponding to the allowed 3% product loss;

- C – Additional yield obtained.

Based on the obtained data, the economic damage threshold (EDT) of melon aphids for various developmental phases of vegetable and cucurbits crops was determined (Table 8).

Table 8 Economic damage threshold of melon aphids on vegetable and cucurbits crops

Variants	EDT (The number of pests on 1 fully damaged leaf on the phases of the plant) on 100% damaged plant		
	5-6 leaves	Budding	Fruiting
Melon	1,5	3,7	18,0
Cucumber	1,5	6,2	21,0
Tomato	12,0	31,5	33,0

Table 8 shows that during the young seedling stage of plants, even a small amount of infestation (an average of 1.5 pests per damaged leaf) causes significant damage. In the case of melons and cucumbers, the permissible damage level of 3% is caused by very few pests, while in tomatoes, it amounts to 12.0 pests per damaged leaf. In the flowering phase, these figures double. Specifically, for melons, it is 3.7 pests, for cucumbers it is 6.2 pests, and for tomatoes, it is 31.5 pests. When pests arrive late, in the fruiting phase, the economic injury threshold per damaged leaf is 18.0, 21.0, and 33.0 pests for melons, cucumbers, and tomatoes, respectively. These figures represent the economic injury threshold for sap-sucking pests and indicate the need for control measures to fully preserve the yield.

Thus, if there are no entomophages present in the plants and pests are at the indicated levels, this indicates that these pests will soon multiply rapidly.

In our next experiment, considering the gathering of pests in wild grasses on the edges of fields to cntrol the first generation that emerges from winter in early spring, we distributed 500-1000 individuals of the ladybug entomophage per hectare as a preventive measure. Upon studying its effectiveness, it was found that the first generation of pests decreased by 56-60% compared to fields where preventive measures were not applied, and their emergence was delayed by 20 days.

Therefore, it is advisable to ensure a higher accumulation of entomophages in crops and to distribute 500-1000 individuals of the ladybug predator, which are grown in additional biolaboratories, per hectare every year in fields affected by pests.

4. CONCLUSION

Based on the conducted scientific research, the following conclusions can be made regarding the composition of pests, emergence dates from hibernation, their distribution on crop species, suitable host plants, and the dynamics of their development during the growing season:

1. In the conditions of Karakalpakstan, from aphids, melon, cowpea, cotton, mealy plum and cabbage aphids develop on vegetable and cucurbits crops. Among these, melon aphids, acacia aphids, and cabbage aphids are predominant.

2. The emergence of aphids from hibernation occurs between April 2 and 10. This means that when the average daily air temperature is around 10-15°C, the pests emerge from their hibernation sites.

3. Melon and cowpea aphids affect cucumber, pumpkin, and melon crops, while cabbage aphids are monophagous and primarily affect cabbage crops, especially late-ripening cabbage, leading to severe damage.

4. The mealy plum aphid, during years of mass development, infests all types of vegetable and cucurbits crops planted in the alleys of fruit orchards in early spring.

5. The cotton aphid occurs on tomatoes, peppers, and eggplants, but its average number per plant does not exceed 1-2 individuals. Therefore, the level of damage caused by this pest is not noticeable.

6. The return of the pest to hibernation sites varies with the average daily temperature; in the years when the experiments were conducted, it was observed that the pests began preparing for hibernation from the end of October and were fully

hibernating by the second decade of November. The hibernation sites for melon, cowpea, and cotton aphids are the remaining plant residues in the fields and wild grasses at the edges of the fields. The melon aphid hibernates in its adult stage, while the cowpea aphid hibernates in its egg stage. The cabbage aphid hibernates in the eggs laid on cabbages, on the roots of harvested cabbages, and in plant residues from the brassica family.

7. Entomophages such as the ladybug, common lacewing, syrphid fly, predatory mites, and aphidiids actively participate in reducing the number of pests on infested plants.

8. Applying 500-1000 individuals of the lacewing entomophage per hectare as a preventive measure against the first generation of aphids emerging from hibernation in early spring regulates pest populations and delays their arrival on plants by 18-22 days.

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