Studii şi Cercetări	Martie 2022	Biologie	31/1	57-61	Universitatea"Vasile Alecsandri" din Bacău

ENTOMOPHAGES ATTRACTION METHOD IN TOMATO FIELD AGROCENOSIS

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Key words*: nectar-bearing cultures of the fam. Apiaceae, fam. Coccinellidae, fam. Aphidoidea, mixed cultivation.*

INTRODUCTION

Modern biosecurity systems should be characterized by low cost, which is ensured by: a) shifting the focus of measures to monitoring, forecasting and prevention; b) maximum use of agrotechnical methods for limiting the harmful activity of insects; c) taking into account and activation of natural biocenotic factors of regulation in agroecosystems. One of the methodological approaches in modern biological plant protection is the creation of permanent entomophage reservations [1].

With the help of nectaros plants, environmental populations activation is possible. Entomophages through the impact on phytophages affect the growth, development and productivity of agricultural plants. Thus, their functional importance is not just in direct participation in the biocenotic process, but also in the formation of the environment. In turn, the regulatory effect of entomophages on phytophages is associated both with the level of density of the population of the latter and with the state of the feed plant, which carries the main load in the provision of substance, energy, information transfer and all the conditions for the existence of the consumers of the first and second order [2].

Nutrients contained in nectar and pollen flowers, in the association with aroma and form attract insect-anthophiles for their own power and feeding larvae.

Thus, the entomophily of flowering plants and anthophilia of insects are two sides of a single, very important for both groups of organisms of the process, which originated and improved in the process of their coevolution [3]. Improving the trophic bonds of entomophages with nectarial plants led to close ontogenetic synchronization of flowering periods and departure of insects from wintering [4]. A close positive correlation between the presence of entomophiles' crops in the fields and the efficiency of cabbage entomophages is noted in the works of B. Apsyakin (2003) [5].

According to him, a high concentration of entomophages is created in the entomophilic crops, and their larvae significantly reduce the number of pests. The aim of our work was to study the method of attracting entomophages (*Coccinellidae*) to the tomato field agrocenosis using nectariferous plants to control pests (*Aphidoidea*).

MATERIALS AND METHODS

Studies were conducted on the fields of the Institute of Genetics, Physiology and Plant Protection. The objects of research were:

1) Aphids (*Aphidoidea* family, *Homoptera*). Imago and larvae sucking juice from leaves. Leaves twist, deform and dry out. Plants slow down growth, yield decreases. In addition, the aphids are the carrier of the causative agents of viral diseases. Economic thresholds of harmfulness on tomato plants 150-350 aphids per plant [6].

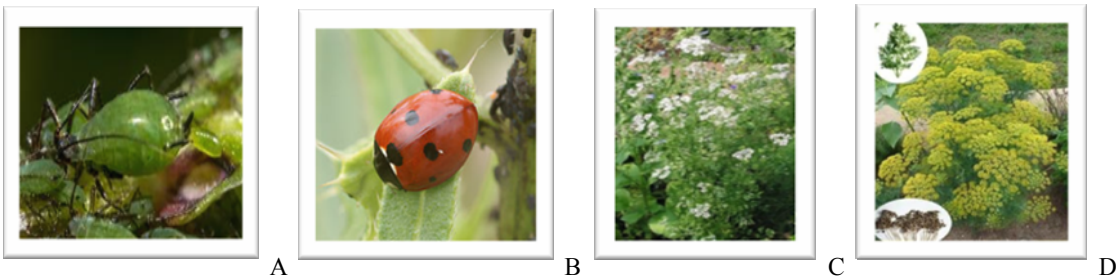
2) Ladybug (*Coccinellidae*, *Coleoptera*), the main entomophage of aphids (more than 5,000 species). The overwhelming majority of ladybugs are predators. Beetles and larvae make a significant benefit to agriculture, feeding in large quantities such dangerous pests, like aphids, worms and mites. The usual representative of the family - *Coccinella septempunctata* L. is especially useful.

3) As nectarous plants, we selected two representatives of the *Apiaceae* family - coriander and dill, which are cultivated as spicy, food and medicinal plants in the Republic of Moldova (Fig. 1 A, B, C, D).

For field experiments, we selected plants combining several properties:

1. Sufficient cold resistance, for early sowing. This is necessary to bring in compliance the phenological phases of pests with phases of plants-satellites. The maximum efficiency of plants is achieved in the flowering phase when the greatest green mass is observed (disorientation, disguise, repellent substances) and the presence of nectarial colors (attracting entomophages);
2. Different flowering times (increasing time of entomophages feeding);
3. The presence of essential substances that repel and disorienting pests;
4. The structure of the entomophile plant flower is attractive for entomophages and is not attractive for pests. *Apiaceae* flowers are

usually actinomorphic and 5-membered, collected in inflorescence. Petals - white, yellow or yellowish green, rarely bluish or pinkish. Due to the widely opened flowers of *Apiaceae*, nectar is accessible to the most diverse insect pollinators. The flowers of *Apiaceae* plants are attractive for entomophages (of the family *Aphelinidae, Coccinellidae, Hymenoptera and Neuroptera*), but are not completely attractive for pest butterflies, as the morphology of a small and open of *Apiacea*e plants flower does not correlate with a long proboscis of butterflies. The proboscis of butterfly is composed of two crescent-shaped, elongated maxillary galeae that come together to form a food canal to transport fluids.



A B C D

Figure 1. Research objects: A) Aphids (f. *Aphidoidea*); B) Entomophages of aphids (f. *Coccinellidae*), C, D) nectarous plants-satellites for tomatoes from the *Apiaceae* family: *Coriandrum sativum* L.; *Anethum graveolens* L.

Phenological observations of the nectarial crops development and flowering were carried out by calculating the number of plants at the accounting plots.

For the beginning of flowering, 10% of flowering plants took, for mass flowering - more than 75% of plants, for the end of flowering - 10% of flowering plants in the crop. Entomophage monitoring was carried out according to standard methods [7]. The species composition of entomophages was determined using the "Determinants of insect species of the European part of the USSR" [8]. The number of phytophages on tomatoes was determined at a different distance from nectarial crops.

The first account was carried out on the edge of the field and the strip of nectarial plants, subsequent - every 50m, in 4 repetitions. The degree of aphid's population on shoots was determined by the method of keeping the pest against the white paper background. Then the average density of the aphids on one plant was calculated. By the density of planting in the crops, the density of the aphids on $1m^2$ was determined.

Accounting was conducted weekly. The effectiveness of aphidophages was calculated at the ratio of predators and aphids according to the formula K = FET / FTL, where the FET is the number of entomophages in the accounting, and FTL - the number of aphids in accounting [9]. For agroecological classification of an experimental field, GIS technology and spatial interpolation in the BIOCLASS program was used. GIS technology we used to identify microzone with different risk of developing harmful organisms [10].

RESULTS AND DISCUSSIONS

Sowing the stripes of nectarial plants f. *Apiaceae*: (*Coriandrum sativum* L., *Anethum graveolens* L.) 2,5 m wide, was carried out at the opposite edges of the field of the main culture of tomatoes, with an area of 1 hectare. As a result of the research, it was found that the sequence of periods of flowering of nectar-bearing crops of Apiaceae family is a prerequisite for the creation of a flowering conveyor that supports the vital activity of entomophages. *Coriandrum sativum* begins flowering in the last ten days of June and *Anethum graveolens* completes the flowering line at the end of August (Table 1).

The main species of the *Coccinellidae* family entomophages, which were found in agrobiocenoses of nectar-bearing crop, were identified: *Coccinella septempunctata* Linnaeus; *Harmonia s*p.; *Hippodamia s*p. (Figure 2).

As a result of the research, it was found that the aphid population in the tomato field was unevenly distributed at the beginning of summer, during the growing season and flowering of nectarifers. The maximum number of pests were located in the center of the field. At a distance of 50 m from the nectariferous strip, the aphid population was minimal.

In the course of our research, we took into account the occurrence of the *Coccinellidae* family entomophages in agrobiocenoses. Based on the results, we traced the positive dynamics of the *Coccinellidae* family entomophages population growth as nectar-bearing crops of the *Apiaceae* family bloom around the tomato field. In July and early August, the population was at its maximum.

During the flowering period of nectarifers, the aphid population was the largest (160,2 ind./m^2).

During the period of dill and coriander full flowering, the aphid population became below the threshold of harmfulness (62,4 ind./m^2). In July, the number of ovipositions and larvae of *Coccinellidae* increased. These data indicate the accumulation of entomophages and an increase in their activity. In the tomato field, the population of the *Coccinellidae* family entomophages increased (1,9 ind./m^2) and significantly reduced the pest population. The maximum number of aphids and the minimum number of entomophages were observed before the flowering of nectariferous plants in June (1:224 ind./m^2).

During the period of full flowering of nectariferous strips from mid-July, the aphid population decreased to acceptable values (below the threshold of damage), and the population of entomophages increased (1:28; 1:18 ind./m^2). At the end of the season, the aphid population sought to restore its numbers, but the accumulated complex of entomophages controlled the pest below the threshold of harmfulness. T

hanks to the spatial interpolation of the results in the BioClass program, it was found that the source of the aphid colonization was the low-lying part of the field, bordering the weed belt (Table 2).

In the tomato agroecosystem, the *Coccinellidae* entomophages cannot fully exist without nectar-bearing flora, just as they cannot do without their victims (f. *Aphidoidea*). A close positive correlation between the presence of entomophilous crops in the fields and the effectiveness of entomophages of tomato pests is noted in the results of our research. Entomophages and their larvae significantly reduce the number of pests, although they do not completely destroy them, as in chemical treatment.

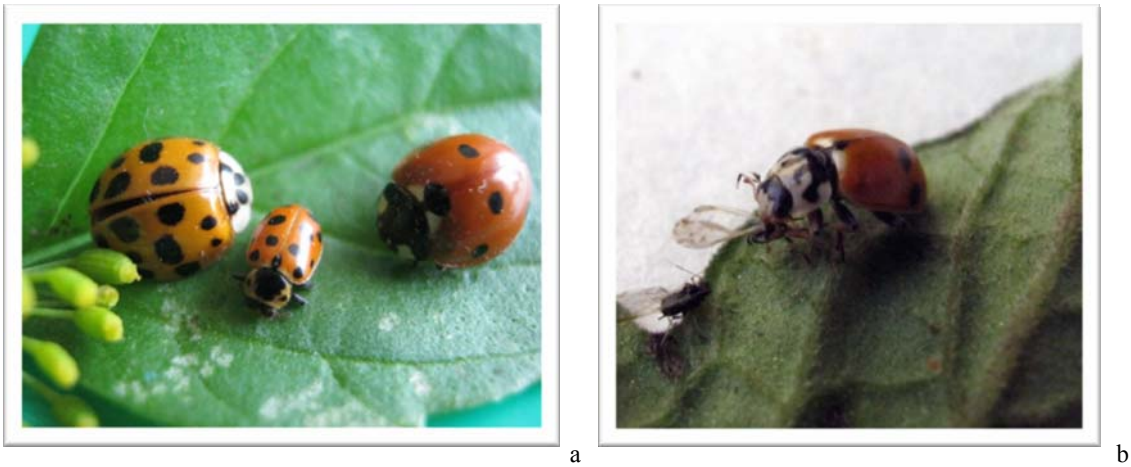
Feeding of predator females on nectariferous plants contributes to the maturation of entomophages sexual production, which serves as a prerequisite for realizing the high potential of their fertility and efficiency. Presented entomophages usually prefer small flowers with accessible nectaries and collected in inflorescences.

At the same time, such small flowers are not attractive to insect pests with a long proboscis. In addition, the *Apiaceae* family plants that we used, have their own agricultural value as spices, herbs, essential oils and medicinal crops.

Table 1. Flowering conveyor of nectar-bearing crops of the *Apiaceae* family

Plant species	June			July			August		
	decades			decades			decades		
	1	2	3	1	2	3	1	2	3
Anethum graveolens L.	-	-	-	*	*	*	*	*	-
Coriandrum sativum L.	-	-	*	*	*	*	*	-	-

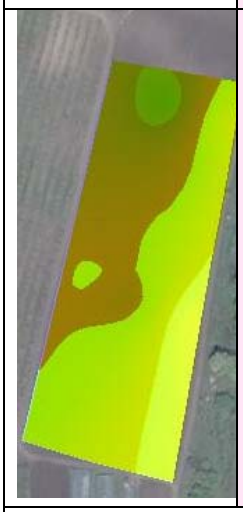
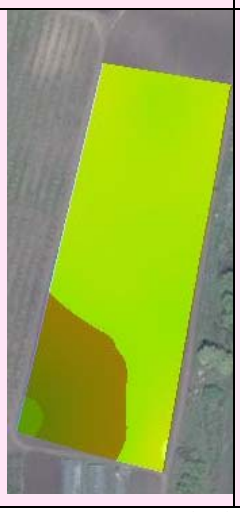
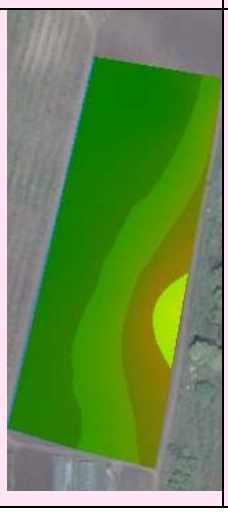
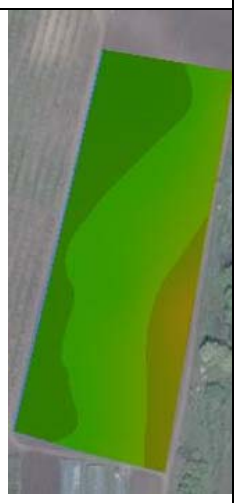
Legend: - growing season; * flowering period.



a b

Figure 2. The main species of the *Coccinellidae* family, which were found in the experimental field: a) *Coccinella septempunctata, Harmonia sp., Hippodamia sp*.; b) *Coccinella septempunctata* feed on aphids on tomatoes

Table 2. Spatial distribution of the pest (*Aphidoidea*) in the tomato field and the ratio of *Coccinellidae: Aphidoidea* in accordance with the phenological timing of flowering of the band of nectariferous plants

Beginning of flowering	Full flowering strip of nectariferous plants			Final flowering
17.06.	28.06.	17.07.	30.07.	14.08.
				
Ratio of *Coccinellidae : Aphidoidea* (ind./m^2)				
1:224	**1:182**	**1:28**	**1:18**	**1:31**

Legend:

color	grade	ind./m^2
	very good	Less than 10
	Good	10-50
	medium	50-100
	bad	100-500
	very bad	over 500

CONCLUSIONS

1. It was noted that coriander (*Coriandrum sativum* L.) and dill (*Anethum graveolens* L.) seeding in a tomato field can create a flowering conveyor that supports the entomophages vital activity from the third decade of June to mid-August.

2. The main species of *Coccinellidae* family entomophages, which were found in agrobiocenoses of nectar-bearing crops of the *Apiaceae* family, were identified: *Coccinella septempunctata Linnaeus; Hippodamia sp., Harmonia sp*.;

3. It was determined that the reduction in the number of *Aphidoidea* pests (up to 40,2 ind./m^2) and increasing the number of *Coccinellidae* entomophages (up to 1,9 ind./m^2) on tomatoes was observed during the period of full flowering of nectar-bearing crops *Anethum graveolens* L. and *Coriandrum sativum* L.

4. It has been found that the most optimal ratio of phytophage/entomophage was formed in late July, early August - the period of flowering of nectar-bearing crops (1:18.0 ind./m^2). The maximum number of aphids and the minimum number of entomophages were observed before flowering of nectariferous plants (1:223.6 ind./m^2);

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ABSTRACT

Many pest populations can be controlled by improving the efficiency of local diversity and the existing community of natural enemies. The aim of our work was to study the method of attracting entomophages (*Coccinellidae*) to the tomato field agrocenosis using nectariferous plants to control pests (*Aphidoidea*). As a result of the research, it was found that the sequence of nectariferous plants (f. *Apiaceae*) flowering periods is a prerequisite for flowering conveyor. It was noted that coriander (*Coriandrum sativum* L.) and dill (*Anethum graveolens* L.) seeding in a tomato field can create a flowering conveyor that supports the vital activity of entomophages from the third decade of June to mid-August. The main species of *Coccinellidae* family entomophages, which were found in agrobiocenoses of nectar-bearing crops of the *Apiaceae* family, were identified: *Coccinella septempunctata Linnaeus; Hippodamia sp., Harmonia sp*. It was determined that the reduction in the number of *Aphidoidea* pests (up to 40,2 ind./m^2) and increasing the number of *Coccinellidae* entomophages (up to 1,9 ind./m^2) on tomatoes was observed during the period of full flowering of nectar-bearing crops *Anethum graveolens* L. and *Coriandrum sativum* L. It has been found that the most optimal ratio of phytophage/entomophage was formed in late July, early August - the period of flowering of nectar-bearing crops (1:18.0 ind./m^2). The maximum number of aphids and the minimum number of entomophages were observed before flowering of nectariferous plants (1:223.6 ind./m^2);

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