ORIGINAL PAPERS

THE TROPHIC RELATIONSHIP BETWEEN PARASITIC ENTOMOPHAGES (HYMENOPTERA: APHIDIIDAE) AND SPECIES OF APHIDS (HOMOPTERA: APHIDIDAE) TO THE WHEAT CROP

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Key words: *wheat, aphids, phytophages, entomophages, seasonal dynamics, phenological dynamics*

INTRODUCTION

It is known that the explosive evolution of insect species occurred at the beginning of the Mesozoic era, in parallel with the development of flowering plant species [4]. Currently, there are approximately 3500 species of aphids (Homoptera, Aphidae) on Earth, of which approximately 318 species are found in the Republic of Moldova [11]. Many weed species serve as intermediate hosts for aphid species. One of the economically important agricultural crops is heavily attacked by different species of aphids every year. Aphids concentrate more on young leaves and feed on the sap of wheat plants. Wheat plants attacked by aphids turn yellow, develop much more slowly, and the leaves twist. For these reasons, new knowledge is needed in studying the biological peculiarities of reproduction, development, as well as in predicting the appearance, and regulating the numerical density of each aphid species, for the effective control of pests in agroecosystems of wheat cultivation. Scientists from several countries are concerned about the role of aphidoids in reducing the numerical density of aphids [1, 3, 5, 8, 10]. Parasitoid entomophages (Hymenoptera, Aphidiidae) develop on aphid species from the Fam. (Aphidae, Homoptera), and is the main vector of infection with phytopathogenic viruses of crop plants. Cultivation of micro reserves with nectariferous and aromatic plant species, which contain in their pollen carbohydrates and extra floral nectar, near agroecosystems with annual agricultural crops, influences the increase of biological reproduction of entomophages by about 3 times [9].

The aim of the paper is to estimate the role of natural entomophagous species from the fam. (Hymenoptera, Aphidiidae) in the biological control of aphid species from the fam. (Homoptera, Aphidae) in the wheat crop.

MATERIALS AND METHODS

The investigations were carried out on the experimental fields of the Institute of Genetics, Physiology and Plant Protection of the Republic of Moldova, in wheat cultivation. The study of qualitative-quantitative biological indices of aphid species (Homoptera, Aphidae) was carried out by the following 4 methods:

-Threading method;

-The method of colored traps;

-The method of recording 4 points of 25 plants each - the number of aphid individuals was related to the number of plants;

-Meriche's method.

The investigations were carried out in the climatic conditions of 2020. The parasitized individuals and mummified aphid colonies collected from the experimental plots, under laboratory conditions, were placed in 0.5liter glass vessels, which were covered with gauze, and in test tubes – which were covered with a piece of cotton. The biological material was exposed to observations until the parasites were excluded from the body of the aphids, with the fixation of the parasite exclusion period. Plus, under laboratory conditions, the parasitoids of the fam. (Aphidiidae, Hymenoptera) were also obtained by keeping leaves, stems, and spikes infested with aphid colonies separately in desiccators, until the parasitoids were excluded from the aphids' body. In addition, the seasonal monitoring of the parasitic entomofauna in Fam. (Aphidiidae, Hymenoptera) and aphid species from the fam. (Homoptera, Aphidae) on the wheat crop using yellow traps. The identification of the faunal material was carried out with the help of entomological determinants [12] and a microscope under laboratory conditions.

The obtained results were subjected to mathematical analyzes according to the Microsoft Excel package.

RESULTS AND DISCUSSIONS

As a result of the investigations and the thorough analysis of the biological material in seasonal dynamics, it was demonstrated that the taxonomic structure of the fam. Aphidae in the wheat crop is mainly composed of the taxa *Schizaphis graminum* L. and *Sitobion avenae* F. (Table 1).

The analysis of the results showed that the aphid species *Schzarium graminium* and *Sitobion avenae* reached the highest degree of population density in the wheat crop in the first decade of June 18,0 and 16.6% respectively. However, it was recorded that the highest degree of spread of the aphid population occurs during the third decade of May and June. Thus, on the surface of one hectare of wheat crop in May there were about 43 outbreaks of aphids, which is -38.7%, in June - 64 outbreaks (49.0%), while in July - only 15 outbreaks of aphids (14%).

During the investigations, it was found that in the agroclimatic conditions of 2020, the first solitary colonies of aphids in the wheat crop (2-3 individuals/100 plants) were registered during the period when the plants reached a height of about 12-14 cm. In most cases, only the species Schizaphis graminum and Sitobion avenae were reported. At the same time, entomophages from the fam. Aphidiidae sp. (genus Aphidius) (Table 2).

The analysis of the obtained results demonstrated that aphids and entomophages reached the highest degree of development when the gray culture entered the phenological phase of budding. Thus, the population density of aphids was 23,0% and that of entomophages – 16,0%. At the flowering phenological phase - both the density of the aphid population (by 6.8% compared to the budding phase) and the entomophagous population (by 6.0% compared to the buttoning phase) was reduced in the gray crop. At the same time, it is necessary to mention that the lowest population density of aphids and entomophages was reported during the phenological phase of wheat grain ripening.

Seasonal dynamic monitoring of aphidophage successions (Aphidius sp. and Ephedrus sp.) demonstrated that major biological indices were reached at the phenological phases of budding, flowering and ear formation of wheat (Table 3).

The obtained results made it possible to highlight some trophic links between entomophagous species and aphids, which predominate in the wheat crop (Table 4).

Thus, 6 species of natural entomophages were highlighted (Aphidina evri Haliday, 1834; Ephedrus sp.; Lysiphlebus sp.; Diaeretiella rapae M. Intosh, 1855; Praon volucre Haliday, 1833; Ephedrus persicae Froggatt, 1904), which can control the density population of the 3 most widespread species of aphids (Schzarium graminium L.; Sitobion avenae F.; Myzodes persicae Sulz.) in the wheat crop.

Table 1. *Schzarium graminium* and *Sitobion avenae* aphid species rate in the seasonal dynamics of the wheat crop

Species	May (%)			June (%)			July (%)
	I decade	II decade	III decade	I decade	II decade	III decade	III decade
Schzarium graminium	3,3	5,3	10,0	18,0	9,5	6,8	2,6
Sitobion avenae	2,2	3,2	8,5	16,6	7,2	4,7	1,2

Table 2. Seasonal dynamic monitoring of aphids (family Aphididae, Homoptera) and of entomophages (family Aphidiidae, Hymenoptera) depending on the phenological phases of wheat crop development

The taxonomic groups	The phenological phases to be developed of the wheat crop				
	Buttoning (%)	Flowering (%)	Spike formation (%)	Spike (%)	Baking (%)
Fam. *Aphididae, Homoptera*	23,0	16,2	11,6	6,9	3,5
Fam. *Aphidiidae, Hymenoptera*	16,0	10,0	6,0	4,0	2,2

Table 3. Seasonal dynamic monitoring of aphids (Aphidius sp. and Ephedrus sp.) depending on the phenological phases of wheat crop development

Genres	The phenological phases of wheat crop development					
	Until the buttoning (%)	Buttoning (%)	Flowering (%)	Spike formation (%)	Spike (%)	Baking (%)
Ephedrus sp.	4,2	17,0	12,0	14,0	11,0	2,6
Aphidius sp.	2,1	14,0	10,0	12,0	9,0	1,2

Table 4. Highlighting the trophic links between entomophagous species and aphids, which predominates in the wheat crop

Entomophagous species (Fam. Aphidiidae, Hymenoptera)	Aphid species (Fam. Aphidae, Homoptera)
Aphidina evri Haliday, 1834	*Schzarium graminium* L.
Ephedrus sp.	*Schzarium graminium* L.
Lysiphlebus sp.	*Sitobion avenae* F.
Diaeretiella rapae M. Intosh, 1855	*Myzodes persicae* Sulz.; *Schzariumgraminium* L.
Aphidina evri Haliday, 1834	*Myzodes persicae* Sulz.; *Schzariumgraminium* L.
Praon volucre Haliday,1833	*Sitobion avenae* F.; *Schzarium graminium* L.
Ephedrus persicae Froggatt, 1904	*Schzarium graminium* L.; *Sitobion avenae* F.

CONCLUSIONS

1. It was demonstrated that the aphid species *Schzarium graminium* and *Sitobion avenae* reached the highest degree of population density in the wheat crop in the first decade of June (18,0 and 16.6% respectively);

2. It was demonstrated that aphids and entomophages reached the highest degree of development when the gray culture entered the phenological phase of budding. Thus, the density of the aphid population constituted 23,0% and that of entomophages – 16,0%;

3. 6 species of natural entomophages (family Aphidiidae, Hymenoptera) were identified, which can control the population density of the 3 most widespread species of aphids in the wheat crop.

ABSTRACT

It was demonstrated that the aphid species Schzarium graminium and Sitobion avenae reached the highest degree of population density in the wheat crop in the first decade of June (18,0 and 16.6% respectively). It was found that aphids and entomophages reached the highest degree of development when the gray crop entered the phenological phase of buttoning. Thus, the population density of aphids was 23,0 % and that of entomophages – 16,0%. 6 species of natural entomophages were highlighted (Aphidina evri Haliday, 1834; Ephedrus sp.; Lysiphlebus sp.; Diaeretiella rapae M. Intosh, 1855; Praon volucre Haliday, 1833; Ephedrus persicae Froggatt, 1904), which can control the population density of of the 3 most widespread species of aphids (Schzarium graminium L.; Sitobion avenae F.; Myzodes persicae Sulz.) in the wheat crop.

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