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SYRPHID COMMUNITIES (SYRPHIDAE, DIPTERA) IN BASIC TYPES OF AGROECOSYSTEMS IN KARLOVO VALLEY (BULGARIA)

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Abstract

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This contribution is the first ecologicaly-faunistic study of the syrphid flies from Karlovo valley. Syrphid cenoses in two basic types of agroecosystems were examined – cereals with merged surface and maize. Fourteen agroecosystems were explored. Main population and cenotic parameters of the syrphid communities were identified and analysed: species composition, evaluated qualitatively and quantitatively; occurrence of the species; population density; general average density; dominant and ecological structure. The study established 14 species syrphid flies. All species were new for the syrphid fauna of the valley.

Key words: syrphid flies, Syrphidae, Karlovo valley, community, biological control

Introduction

Flies from the family Syrphidae are a major group bioregulators of the density of a large number of pests in agriculture and forestry. The density of predatory syrphid flies increases in direct proportion with the increasing of the number of the pest. At small density of the pest, they fully suppress it, and at its high density, they maintain it below the threshold of economic harm (Adashkevich, 1975). These characteristics define them as extremely promising bio-agents in the fight against the organisms harmful to plants.

The use of syrphid flies is impossible without an inventory of the resources available, without a thorough knowledge of the species composition and number of ecological characteristics, such as degree of occurrence, density of populations, set of dominants and trophy specialization of the species.

This study is the first ecologically-faunistic investigation of the syrphid flies in the Karlovo valley area. Its purpose is to contribute to the replenishment of the database, determining the actual status of this important for the functioning of ecosystems group insects in Bulgaria and hence to its sterling use for the purposes of the biological and integrated pest control.

Material and Methods

During the investigation were examined 14 agroecosystems, of which 7 sown with cereals with merged surface (4 with wheat and 3 with rye) and 7

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sown with maize. Wheat ecosystems were situated near Klisura, Karlovo, Vasil Levski and Domlyan and ecosystems with rye – near Stoletovo, Karavelovo and Voynyagovo. Maize ecosystems were near Klisura, Stoletovo, Karavelovo, Voynyagovo, Karlovo, Vasil Levski and Domlyan.

The material of syrphid flies was collected in a way allowing qualitative and quantitative assessment. The method of "mowing" was used, with a standard entomological sack with a diameter of 30 cm. The material collection was carried out in dry and quiet weather before noon. Ten samples of each ecosystem in each gathering were taken. The number of swathes in each sample was 50, and the average length of the swath was 1 m. Only adult stages of syrphid flies were reported.

For determination of the taxonomic similarity between the faunistic complexes in the different ecosystems and between the complexes of main species was used the coefficient of Jaccard (Wallwork, 1976) and the degree of proximity between the complexes was assessed by Zlotin (1975). The similarity in population density was determined by the coefficient of Jaccard-Naumov (Chernov, 1975). Dominant structure of the communities was established in 4-grades classification of Arzamasov, Dolbik, Hotko and Shevtsova (Hotko et al., 1982), and the species occurrence – in 3-grades classification of Bodenheimer and Balogh (Dazho, 1975). The population density was calculated by the method of Gilyarov (1974), and the data on the average density were statistically processed and were shown for 1 ha.

Results and Discussion

Species composition

During the investigation 14 species syrphid flies belonging to 6 genera from subfam. Syrphinae and 2 genera from subfam. Milesiinae were established (Peck, 1988).

All identified by the survey species were communicated for the first time for the syrphid fauna of Karlovo valley.

The established species and their density in the different ecosystems were presented in Tables 1 and 2

Species composition in the two examined types of agro-ecosystems differed in the number of their components. In the cereals with merged surface were established 12 syrphid flies and in the maize ecosystems the number of the found species was double less – 6 species.

Within the cereal ecosystems with most species was distinguished the wheat near Domlyan – 7 species found, and most impoverished was the wheat ecosystem near Karlovo – only 4 species. Ecosystems with rye near Stoletovo, Karavelovo, Voynyagovo and the ecosystem with wheat near Vasil Levski had 6 species each and those with wheat near Klisura had 5 species.

Among the tested maize ecosystems richest in species (6 species) was the ecosystem near Voynyagovo, and with least species number (3 species) - the ecosystem near Klisura. Five syrphid species were found in the maize ecosystems near Stoletovo and Domlyan, and 4 - in the ecosystems near Karavelovo, Karlovo and Vasil Levski.

Syrfid complexes in the studied ecosystems varied not only by the number of their forming components, but also by qualitative composition. Taxonomic similarity between the species spectra of the two types agroecosystems was low – 29 %, which illustrated the major qualitatively disparity between them. Taxonomic difference between syrfid complexes also underlined in comparing the species complexes within the limits of the same type of crop. The differences between the species composition in the various points of cereals with merged surface in most of the cases (11 cases) were too large. The largest difference was observed between the ecosystems with rye near Stoletovo and Voynyagovo (taxonomic similarity between species spectra was only 20 %). In 6 of the cases similarity was medium, and it was high in 4 of the cases. Qualitatively closest to each other were the ecosystems with rye near Voynyagovo and the one with wheat near Domlyan and

Table 1

Species composition and numbers (number individuals.ha^{-1}) of the syrphid flies in the investigated cereals with a merged surface

Species	Klisura		Stoletovo		Karavelovo		Voynyagovo		Karlovo		Vasil Levski		Domlyan	
	2 June	29 July	2 June	29 July	2 June	29 July	2 June	29 July	2 June	29 July	2 June	29 July	2 June	29 July
Episyrphus balteatus (Deg.)		67	67	133	67	133					67	133	67	133
Metasyrphus corollae (Fabr.)	67	133					67	200	67	133		67	67	
Sphaerophoria menthastri (L.)					67		67							
S. rueppelli (Wied.)						67								
S. scripta (L.)	67		67	200	67	333	133	200		200	67	133	133	200
Syrphus vitripennis Mg.				67										
Melanostoma mellinum (L.)			67	133				67					133	133
Paragus tibialis (Fall.)		67		67		200								
Eristalis arbustorum (L.)							67	133					133	67
E. nemorum (L.)												67	67	133
E. tenax (L.)	67	133		67					67	133	67	133		
Syritta pipiens (L.)						200	67	200		200			67	133

also the wheat ecosystems near Vasil Levski and Domlyan (with taxonomic proximity 63 %). High similarity was found also between the wheat ecosystem near Klisura and the ecosystem with rye near Stoletovo, and between the ecosystems with wheat near Klisura and Vasil Levski (taxonomic affinity 57 %).

The situation in ecosystems with maize was rather different. In only one of the cases the taxonomic similarity was low – between ecosystems near Vasil Levski and Karlovo (taxonomic similarity was only 10 %). The other maize ecosystems were closer in terms of their species composition. Average qualitative proximity was determined in 3 of the cases, and the taxonomic proximity was high in most of the cases – 17. Qualitatively closest were the ecosystems with maize near Stoletovo and Voynyagovo and those near Voynyagovo and Domlyan (taxonomic affinity between them – 83 %).

In conducted examination the impression was that the more abundant species composition of syrphid flies in cereals with merged surface in Karlovo valley (12 species), compared with those in the neighboring Zlatitsa-Pirdop (8 species) and Kazanlak (6 species) valleys (Markova, Tsonev,

Table 2

Species composition and numbers (number individuals.ha-1) in the investigated ecosystems with maize

Species	Klisura		Stoletovo		Karavelovo		Voynaygovo		Karlovo		Vasil Levski		Domlayn	
	3 June	30 July	3 June	30 July	3 June	30 July	3 June	30 July	4 June	31 July	4 June	31 July	4 June	31 July
Episyrphus balteatus (Deg.)	67	133		67	67	200	67	267	67	67		67	67	200
Metasyrphus corollae (Fabr.)		67	67	133			67	200	67			133		133
M. luniger (Mg.)								133						67
Sphaerophoria philanthus (Mg.)				67	67	133		133		67	67		67	67
S. scripta (L.)	67	133	67	133	133	133	200			133	133	67	200	200
Syritta pipiens (L.)				200		67	67							

1993; Markova, 2003). Taxonomic similarity between species spectra in the wheat ecosystems of the Zlatitsa-Pirdop and Karlovo valleys was 54 %, i.e. average. The taxonomic composition in the wheat ecosystem in Kazanlak valley, however, was quite different from the one found in the wheat and rye ecosystems in Karlovo valley. The similarity between them was only 33 %, i.e. – low. Regarding the species range in maize ecosystems, Karlovo and Kazanlak valleys had the same number of species – 6 in each of them, and an average taxonomic similarity of 38 %.

In the researched area not all of the species had the same degree of occurrence. In the cereals very wide distribution for the period of the study (with occurrence more than 50 % of the points of study) had: *E. balteatus, M. corollae, S. scripta* and *E. tenax*. As a subsidiary species (with occurrence levels of 25-50%) were established 4 species – *M. mellinum, E. arbustorum* and *S. pipiens*. The remaining 4 species (with occurrence < 25 %) were incidental components of the ecosystems. In the maize ecosystems with the highest degree of occurrence were *E. balteatus, M. corollae S. philanthus* and *S. scripta*. The remaining 2 species in the maize ecosystems were incidental.

Population density

The density of syrphid flies in both examined types of agroecosystems was not the same. The general average density in the ecosystems with cereals was 490 ± 46 ind.ha^{-1}. In the ecosystems with maize density was 357 ± 37 ind.ha^{-1}, i. e. 1.4 times lower than in the cereals. This difference has been demonstrated statistically ($P<0.01$).

Within the same type of ecosystem, differences in the density of the syrphid complexes were expressed in varying degrees (Figure 1).

In ecosystems of cereals with merged surface average density was highest in wheat near Domlyan – 733 ± 107 ind.ha^{-1}. Density in the wheat ecosystem near Klisura was lowest – 300 ± 102 ind.ha^{-1}, i.e. 2,4 times lower than that established in the ecosystem near Domlyan ($P<0.001$). It was also mathematically proven the difference between the densities established in the ecosystem near Domlyan and those near Karlovo and near Vasil Levski ($P<0.01$). The distinction between the density established in the ecosystem near Domlyan and the other ecosystems with rye was inessential.

In ecosystems, planted with maize in the separate points the average density varied in lower limits than that found in the cereals. With

highest average density was the ecosystem near Voynyagovo – 567 ± 111 ind.ha^{-1}, and with lowest – the ecosystem near Karlovo – 200 ± 70 ind. ha^{-1}, i.e. 2.8 times lower than in the ecosystem near Voynyagovo ($P<0.01$). Mathematically authentic were also the differences of density in the ecosystem near Voynyagovo with those in the ecosystems near Klisura and Karlovo ($P<0.01$). Density in the other ecosystems was only marginally lower than that found in the maize ecosystem near Voynyagovo.

The difference between the syrphid complexes in the separate groups of ecosystems was illustrated by the Jaccard-Naumov coefficient (K_{JN}) calculated by the density of populations of the different species.

The difference by density between the various ecosystems with cereals was significant and was between 8% and 47%, i.e. low to medium. In the most of the cases (13 cases) there was a great difference in the density of syrphid flies between the various ecosystems. In 8 of the cases, the difference was within the average.

The similarity by density of the populations in the maize ecosystems between the separate points showed higher values. The similarity was between 35 to 64%, i.e. medium to high. In 15 of the cases, the similarity by density of populations was average, and in 6 cases – similarity was high. Rather close in density were the ecosystems near Klisura and Karlovo, Klisura and Vasil Levski, these near Stoletovo and Vasil Levski, near Karavelovo and Domlyan and the ecosystems near Voynyagovo and Domlyan and near Karlovo and Vasil Levski. The similarity in density of the populations between them varied from 55 to 85%.

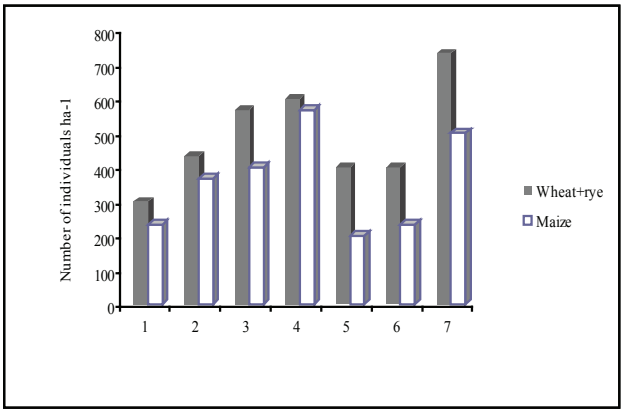

Fig. 1.Syrphid flies density in the investigated agroecosystems: 1 – Klisura; 2 – Stoletovo; 3 – Karavelovo; 4 – Voynyagovo; 5 – Karlovo; 6 – Vasil Levski; 7 - Domlyan

Dominant structure

Of all the species, those which form the main core in the coenoses, i.e. those species with relative importance by numbers ≥10% in the separate agro-ecosystems were not so many. In the cereal cultures with merged surface dominant were 5 species. With largest relative importance (27%) was *S. scripta*, and the other dominants – *E. balteatus, M. corollae, E. tenax* and *S. pipiens* had respectively 13%, 12%, 10% and 13% of relative importance. The total percentage share of the main species of all individuals in cereals ecosystems was 75%.

In the ecosystems with maize the main species by numbers were 4 – *E. balteatus, M. corollae, S. philanthus* and *S. scripta*. Their relative importance was respectively 26.7%, 17.3%, 13.3% and 32%. With the highest degree of dominance (32%) again was *S. scripta*. To the dominant species in the maize ecosystems accrued 89.3% of the total number of individuals.

The proximity between the complexes of dominant species in both types of agro-ecosystems, evaluated with the scale of Zlotin (1975), was average (50%), i.e. in respect to the main species the two types of ecosystems were not too close.

Within the limits of the particular types of ecosystems the similarity between the complexes of dominant species varied differently. In the cereal ecosystems similarity varied from 17% to 60%, i.e. from low to high. In only two of all the cases the closeness between the compositions of dominant species was high – that was between the cereal ecosystems near Klisura and Vasil Levski and between the rye ecosystem near Voynyagovo

and the wheat ecosystem near Karlovo. In 9 of the cases of comparison the similarity was average, and in the most of the cases (10 cases) complexes of main species differed considerably.

In the ecosystems with maize the situation was more different. Most of the ecosystems had rather close composition of key species. The similarity in dominants varied from 20% to 100%, i.e., from low to absolute. Only in two of the cases a significant difference of the dominant complexes was observed.

This was between the complex of dominant species in the ecosystem near Stoletovo and those in the ecosystems near Voynyagovo and Karavelovo.

In 5 cases the similarity was average, and greater was the number of cases with high similarity – 11 cases. In 3 of the cases of comparison the similarity was absolute – between the dominants complexes in the ecosystems near Karlovo and Vasil Levski, Karlovo and Domlyan and those in the ecosystems near Vasil Levski and Domlyan.

Ecological structure

The species of syrphid flies identified in this study belonged to two ecological groups according to the food specialization of the larvae stages – predators and saprophagous.

The group of the predators was present with the largest number of species– 10 species, which consisted 71.4% of the found species.

Saprofagous were represented by 4 species which was 28.6% of the total number of taxa.

The picture was similar also in terms of the numbers of the different trophic groups. Predators were 80% and saprofagous – 20% of the total number of individuals.

Of the prey species with highest number were *E. balteatus* and *S. scripta*, and of saprofagous – *S. pipiens*.

Conclusion

For the first time there were identified and analysed the main population and coenotic structure parameters of the syrphid communities in certain types of agroecosystems of the Karlovo valley.

All of the found species appeared to be new for the syrphid fauna of the valley.

The study complements the knowledge and extends the possibilities for the successful use of one undoubtedly beneficial group of entomophags as a regulatory factor in the biological control system.

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