

INFLUENCE OF THE THIACTLOPRID INSECTICIDE ON SYRPHID COENOSE (DIPTERA: SYRPHIDAE) IN WHEAT AGROECOSYSTEM

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ABSTRACT

Influence of Thiacloprid insecticide on the syrphid community was examined under field trial. Preparation was used in wheat agroecosystem in dose 200 ml/ha to combat Corn Ground Beetle *Zabrus tenebrioides* Goeze. Traced was the influence of the pesticide on the main population and coenose parameters of the syrphid community: species composition, density of the populations of individual species, dominant structure and common average density of the community.

Key words: *Diptera, Syrphidae, insecticide, Thiacloprid, coenose.*

Introduction

Information on the impact of pesticides on the beneficial components of ecosystems are not many, and on the impact of the Thiacloprid insecticide specifically on the syrphid flies in general are missing. The purpose of this study was to establish the impact of Thiacloprid on following basic population and coenotic characteristics of the syrphid communities: species composition, density of population, dominant structure and common average density.

Material and methods

The study was conducted in 2008 in wheat agroecosystem in the village of Trud, Plovdiv district. Insecticide was entered by the preparation Biscaya 240 OD (containing the active substance Thiacloprid) against the Corn Ground Beetle *Zabrus tenebrioides* Goeze. The preparation was used on an area of 5 ha in dose 200 ml/ha. Treatment with the insecticide was made on 15th of May 2008.

Sampling was carried out by a well-established and validated methodology for such kind of researches. For this purpose it was used the method of “mowing” with a standard entomological sack with a diameter of 0.30 m. In any sampling 50 samples were taken. Each sample represented 50 swaths with the entomological sack with average length of one swath – 1 m. Syrphid flies material was collected 9 times – on the day immediately before the treatment with the preparation and during the 1st, 3rd, 6th, 10th, 15th, 20th, 25th and 30th day after the application. Collection of the material was carried out in similar weather conditions – in warm and quiet time, before noon.

Changes in species composition of the syrphid complex under the influence of the insecticide, as well as of the complex of dominant species were given by the index of Jaccard (Wallwork, 1976), and assessed by the classification of Zlotin (1985). Density of populations of individual species was calculated by the method recommended by Gilyarov (1974). Data for the total average density were interpreted by the generally accepted variation-statistical methods. The similarity in the density of populations was defined by the index of Jaccard-Naumov, and the dominant structure was estimated according to classification of Arzamasov et al. (Hotko et al., 1982). Changes in the species structure of the syrphid community were analyzed also by the indices for concentration of domination (*D*) of Simpson, species richness (*d*) of Margalef and total species diversity index (*H*) of Shannon-Weaver (Odum, 1975). The same indices were also used for assessment of the environmental conditions in the studied agroecosystem.

Results and discussion

Species composition

On the basis of this study the total of 11 syrphid species were found. Of these 8 species belong to the subfamily Syrphinae and 3 species – to the Eristalinae subfamily. Syrphinae larvae are eminent predators with great importance for maintaining the density of many agriculture pests populations under the threshold of economic harm. Eristalinae larvae eat rotting organic matters and have important role in the maintenance of the circle of substances in nature.

Established species of syrphid flies and their population density (number of individuals/ha) in the individual samplings were presented in Table 1.

Table 1. Established species and their density (number individuals/ha) in the wheat agroecosystem before (A) and after (T) Thiachloprid application

Species	Number individuals/ha								
	A	T							
	14.05	16.05	18.05	21.05	25.05	30.05	04.06	09.06	14.06
<i>E. balteatus</i> (De Geer)	40	13	27	27	13	40	40	53	27
<i>M. corollae</i> (Fabr.)	53			13	27		13	27	40
<i>S. philanthus</i> (Meig.)						27	40	27	13
<i>S. scripta</i> (L.)	66	27	27	27	40	40	27	53	53
<i>S. ribesii</i> (L.)	13		13		13				
<i>S. vitripennis</i> (Meig.)	13				27	13	27	27	27
<i>M. mellinum</i> (L.)	53	27		27		40	40		53
<i>P. tibialis</i> (Fall.)	40			13	27	13	27	40	
<i>E. horticola</i> (De Geer.)						13		27	13
<i>E. intricaria</i> (L.)	13				13		27	13	40
<i>S. pipiens</i> (L.)	66	27	27	13	27	40	40	53	66

Data in Table 1 showed that right after the use of the preparation the number of species was reduced till the 15th day inclusive, in comparison with the non-treated area. The reduction was with 55.6 %, 55.6 %, 33.4 %, 11.2 % and 11.2 % respectively during the 1st, 3rd, 6th, 10th and 15th day. In the other readings of the insecticide action the number of species was equal to that in the area before the use of the preparation.

Three of the syrphid species – *E. balteatus*, *S. scripta* and *S. pipiens* presented at all samplings of this study. Other species were more or less affected by the used insecticidal preparation. Two of the species – *S. philanthus* and *E. horticola* were found for the first time after the treatment with the insecticide.

Studied insecticide affected the qualitative composition of the species complexes, but its action was less expressed than in respect of the number of species. Taxonomic similarity between the complexes of syrphid flies in the area before and after the treatment with the insecticide in the individual readings ranged from 44% to 89%, i.e. from “medium” to “very high”. In the 1st, 3rd and 15th day after the use of the preparation “median” taxonomic proximity with the species composition before the treatment was found – respectively 44%, 44% and 55%. During the 6th, 20th, 25th and 30th day after the insecticide application similarity with the taxonomic composition in the area before the treatment was respectively 67%, 80%, 64% and 64%, which was assessed as “high” taxonomic vicinity. Only during the 10th day taxonomic similarity with that in the area before the use of the preparation was “very high” – 89%.

Population density

Effects of the insecticide preparation Biscaya 240 OD on the density of populations of syrphid flies were manifested significantly more clearly (Table 1).

The data suggested that the impact of the insecticide preparation has different effect in relation to the individual species, but in the all cases it was negative and particularly strong during the first days of sampling. The one species that only at the end of the investigation period were with a similar density to that recorded in the area before the treatment were *S. scripta*, *M. mellinum* and *S. pipiens*. More negatively affected were *M. corollae*, *S. ribesii*, *S. vitripennis*, *P. tibialis*, and *E. intricaria*.

Negative effects of the insecticide appeared also in comparing density of populations of the complexes of syrphid flies in the individual samplings with that before the treatment. The similarity was 26%, 26%, 33%, 46%, 63%, 60%, 76% and 73% in relation to the non-treated area respectively in the 1st, 3rd, 6th, 10th, 15th, 20th, 25th and 30th day after the use of the insecticide. This showed a very “low” quantitative proximity between the species complexes, which was especially pronounced up to the 6th day of testing the action of the preparation. After the 15th day difference in density of populations in the individual readings in relation to that in the non-treated area was no longer found.

The study showed that the used insecticidal preparation affects very negatively mostly the total density of the syrphid flies. Immediately after the use of the preparation (during the 1st, 3rd and 6th day) the average density of the syrphid flies was respectively 3.9, 3.9 and 3 times lower than the established prior the treatment, and this reduction was confirmed with the highest degree of statistical reliability ($P < 0.001$). In the 10th and 15th day after the treatment the average density of the syrphid community was 1.8 and 1.6 times lower ($P < 0.01$), and in the 20th day it was 1.3 times lower ($P < 0.05$) than that in the area before the use of the insecticide. During the last two days of testing the effects of the preparation (25th and 30th day) total average density continued to be lower than that established in the area before the treatment, but the distinction was no longer statistically confirmed ($P > 0.05$).

Unlike the action of some other pesticides tested on the structure of syrphid coenoses (Markova, Dimcheva, 1998; Markova, Lyubenova, 1998) Thiachloprid insecticide showed too prolonged and strong negative effect against the total density of the syrphid community.

Dominant structure

The fact that in the poorer communities (such as agrobiocoenoses) dominant structure is relatively impoverished was confirmed in this survey. Levels of recedents and subrecedents were missing. This fact was also reported in other similar researches (Markova, 1996; Markova, Dimcheva, 1998; Markova, Lyubenova., 1998; Markova, 2003; Markova, Aleksiev, 2003).

The results of the study (Table 2) indicated that the impact of the Thiachloprid insecticide on the dominant structure of the syrphid community was not very strongly displayed. This was evident especially in respect of the taxonomic composition of the complexes of dominants and, to a lesser extent in respect of the number of the main species in the individual readings. The similarity between the complexes of main species in the area before and after treatment in the individual samplings ranged from 67 to 100%. Assessed by the classification of Zlotin (1975) this meant that there was no difference between the taxonomic composition of dominant species in the area before and that laid down in the individual readings after the treatment.

Constantly dominant species for the whole period of the study was only *S. pipiens*.

Indices for species structure of the community

The presence of negative influence of the Thiachloprid insecticide on the species structure of the syrphid community was confirmed also with the analysis implemented by the indices d , H and D (Table 2). These indices have proven informative value for the state of the ecological situation in

the tested environment. Indices *d* and *H* immediately after treatment with the insecticide showed a lower species variety of the syrphid coenose in comparison with that in the area before the use of

Thiacloprid; that respectively indicated deteriorating environmental conditions. The higher value of

D until the 15th day after the treatment led to the same conclusion, that the environmental conditions

immediately after the use of the preparation were not favourable for the syrphids. The situation was regularized only after the 10th to 20th day of reporting the impact of the pesticide.

Table 2. Dominance (relative significance, %) and some basic indices for species structure of the syrphid community in the wheat agroecosystem before (A) end after (T) Thiacloprid application; *S* – number of species, for other abbreviations – see Material and methods

Species	Relative significance, %								
	A		T						
	14.05	16.05	18.05	21.05	25.05	30.05	04.06	09.06	14.06
<i>E. balteatus</i> (De Geer)	11.0	14.0	28.5	22.0	7.0	18.0	14.0	17.0	8.0
<i>M. corollae</i> (Fabr.)	15.0			11.0	14.0		5.0	8.0	12.0
<i>S. philanthus</i> (Meig.)						12.0	14.0	8.0	4.0
<i>S. scripta</i> (L.)	18.5	28.5	28.5	22.0	21.4	18.0	9.5	17.0	16.0
<i>S. ribesii</i> (L.)	4.0		14.0		7.0				
<i>S. vitripennis</i> (Meig.)	4.0				14.0	6.0	9.5	8.0	8.0
<i>M. mellinum</i> (L.)	15.0	28.5		22.0		18.0	14.0		16.0
<i>P. tibialis</i> (Fall.)	11.0			11.0	14.0	6.0	9.5	12.5	
<i>E. horticola</i> (De Geer)						6.0		8.0	4.0
<i>E. intricaria</i> (L.)	4.0				7.0		9.5	4.0	12.0
<i>S. pipiens</i> (L.)	18.5	28.5	28.5	11.0	14.0	18.0	14.0	17.0	20.0
<i>d</i>	5.5893	3.5502	3.5502	5.2399	6.1076	5.6892	6.0503	5.7962	5.7228
<i>H</i>	0.8871	0.5866	0.5866	0.7527	0.8705	0.8549	0.9336	0.9175	0.9023
<i>D</i>	0.1407	0.2640	0.2640	0.1845	0.1423	0.1471	0.1198	0.1270	0.1360
<i>S</i>	9	4	4	6	8	8	9	9	9

Conclusions

The influence of the Thiacloprid insecticide occurred quickly, strongly and negatively on the number of species syrphid flies, and in lesser extent it affects the quality composition of the syrphid complexes.

The negative impact of Thiacloprid on the density of populations of syrphid flies was displayed immediately after its application. The used insecticide showed too strong and prolonged negative effects particularly in relation to the total density of the syrphid community. Immediately after the use of the preparation the average density was proved ($P < 0.001$) to be 3.9 times lower when compared with that established prior to treatment.

Influence of the insecticide on the dominant structure of the community was not very expressed. This was evident especially in respect of the taxonomic composition of the complexes of dominants and to a lesser extent, to the number of dominant species in the individual samplings.

Used parameters for species structure of the communities confirmed the results of other qualitative and quantitative indices and clearly showed an impaired environmental situation for the syrphid coenose immediately after the application of the pesticide.

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