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EFFECTS OF THE FUNGICIDE PREPARATION VITRA 50 HR ON THE SYRPHID COENOSE (DIPTERA: SYRPHIDAE)

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Abstract

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This study examined the impact of the fungicide preparation Vitra 50 HR (with an active substance copper hydroxide (Cu $(OH)_2$) with concentration of 87.7%, produced by Industrial Quimical del Valles, Spain) on the syrphid coenose in a potato agroecosystem. Preparation's influence was tested on the species composition of the syrphid flies in quantitative and qualitative relation, density of populations of the different species, total average density, dominant structure and some basic characteristics of the species structure of the communities.

The studied fungicide has relatively light impact upon the basic indices of the syrphid coenose only during the first one to three days after its application, which appears to be quickly surmounted.

Key words: Diptera, Syrphidae, fungicide, species composition, community

Introduction

Despite their negative impact on the environment, the use of pesticides continues to grow and it is believed that this trend will be maintained in the recent future (Melnikov, 1973). Therefore the question about the elaboration of an adequate ecological passport for the created preparations and the need they to be subjected to a preliminary and precise testing is topical (Medved, 1977). The fact that the accompanying information about the properties of pesticides not always reflects their maximum possibilities for the conditions in which they are applied must not be overlooked. This requires an active research work, even after the official registration of the preparations. It would provide enormous economies of resources, enhanced efficiency of plant-protection activities, and most important – protection of the environment.

In the specialized scientific literature, the information of the fungicide effects on syrphid communities is scarce. We have data only for an examination of the impact of a Propiconazole containing preparation on the syrphid community in a wheat agroecosystem (Markova and Teofilova, 2011). The present study is the first one assessing the impact of a copper containing preparation on one important for the ecosystems functioning group of insects – the syrphid flies.

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Material and Methods

The effects of the fungicide preparation were explored in a field trial in the agricultural territories of the village of Belchin, municipality of Samokov, in potato ecosystem with area of 5 ha. The study was conducted in the period from 5th to 21st of August 2009. The fungicide was used in dose of 150 g. da^{-1} to control the potato mildew disease. The treatment was carried out on 6th of August with ordinary terrestrial agricultural equipment.

Syrphid flies material was collected in accordance with well-established methodology for sampling in such studies, enabling subsequent quantitative and qualitative processing of the collected material. For this purpose it was used the method of "mowing" with a standard entomological sack with a diameter of 0.30 m. Generally, 6 samplings were committed.

The first material collection was carried out on the day immediately before the treatment with the preparation – 5th of August, and the fungicide action was assessed consistently on the 1st, 3rd, 5th, 10th and the 15th day after its application. In any of the material collections, 50 samples were taken. Each sample represented 50 swaths with the entomological sack with average length of one swath – 1 m. Collection of the material was carried out in similar weather conditions – in warm and quiet time, before noon.

For assessment of the effects of the fungicide on the general taxonomic composition of the syrphid community and on the complexes of dominant species in the area before and after the treatment, the index for taxonomic similarity of Jaccard was used (Wallwork, 1976). Assessment of taxonomic proximity was made according to the classification of Zlotin (1975). Density of population was calculated by the method recommended by Gilyarov (1974). Data about the total average density was processed by the generally accepted statistical variation methods. For evaluation of the differentiation between the syrphid complexes before and after the fungicide application, the index of Jaccard-Naumov for similarity in density of population (Chernov, 1975) was used. The dominant structure of the syrphid community in the studied area before the treatment and at the individual readings of the fungicide impact, was defined according to the classification of Arzamasov et al. (Hotko et al., 1982). Ecological parameters recommended by Odum (1975) were used for analysis of the species structure of the syrphid coenose and for assessment of the ecological conditions in the area before and after the treatment with the preparation – Simpson's index for concentration of domination (D), Margalef's index for species richness (d), Pielou's index for evenness (e) and Shannon-Weaver's total species diversity index (Ħ).

Results and Discusion

Species composition

During the investigation the 12 syrphid species were established, of which 8 species from the Syrphinae and 4 species from the Milesiinae Subfamily (Peck, 1988). The data about the syrphid species from the individual samplings and their population density (number of individuals.ha^{-1}) were presented in Table 1.

The study showed that the fungicide preparation Vitra 50 HR has some negative impact on the number of species immediately after its use, but its effects appeared to be quickly surmounted. In comparison with the non-treated area the reduction of species' number immediately after the treatment (during the 1st day) was 33%, and in the 3rd day – 11%. In the subsequent reports the number of species was equal to or higher than that determined in the non-treated area. In a similar study of the impact of another used in agriculture fungicide – Propiconazole, it was indicated relatively weaker negative reaction in relation to the number of species in the syrphid coenose (Markova and Teofilova, 2011).

Implemented investigation however showed that in qualitative relation Vitra 50 HR did not affect the taxonomic composition of the syrphid complexes. Calculated according to Jaccard taxonomic similarity between species composition in the area before and after application of the prepa-

Table 1
Established species, their density (number individuals.ha-1), dominance (relative significance, %) and some basic cenotic parameters of the syrphid community in the field before (A) and after (V) Vitra application. S - number of species; for other abbreviations - see material and methods

Chronology		A		V1		V3		V5		V10		V15	
	Indice	Den-	Domi-	Den-	Domi-	Den-	Domi-	Den-	Domi-	Den-	Domi-	Den-	Domi-
Species		city	nance	city	nance	city	nance	city	nance	city	nance	city	nance
Episyrphus balteatus (De Geer, 1776)		53	14.8			27	11.1	27	9.5	40	11.1	40	10
Metasyrphus corollae (Fabricius, 1794)		67	18.5	40	23.1	40	16.7	53	19	53	14.8	80	20
Sphaerophoria rueppelli (Wiedemann, 1830)										13	3.7	27	6.7
Sphaerophoria scripta (Linnaeus, 1758)		93	25.9	67	38.5	53	22.2	67	23.8	93	25.9	80	20
Melanostoma mellinum (Linnaeus, 1758)								40	14.3			27	6.7
Platycheirus clypeatus (Meigen, 1822)						13	5.6			13	3.7		
Platycheirus podagratus (Zetterstedt, 1838)		13	3.7					13	4.8				
Paragus tibialis (Fallen, 1817)		27	7.4	13	7.7	13	5.6			27	7.4	13	3.3
Chrysogaster viduata (Linnaeus, 1758)		13	3.7	13	7.7			13	4.8			13	3.3
Eristalis arbustorum (Linnaeus, 1758)		27	7.4	13	7.7	40	16.7	27	9.5	40	11.1	27	6.7
Eristalis tenax (Linnaeus, 1758)		40	11.1	27	15.4	27	11.1	27	9.5	40	11.1	53	13.3
Syritta pipiens (Linnaeus, 1758)		27	7.4			27	11.1	13	4.8	40	11.1	40	10
H		2.0117		1.5857		1.9853		2.0421		2.0461		2.1414	
D		0.155		0.2426		0.1481		0.1476		0.1466		0.1332	
d		2.4273		1.9494		2.4218		2.6277		2.4273		2.6461	
e		0.9155		0.885		0.9547		0.9294		0.9312		0.93	
S		9		6		8		9		9		10	

A - situation before the fungicide application; V1, V3, V5, V10 and V15 - situation respectively on the 1-st, 3-rd, 5-th, 10-th and 15-th post-treatment day

ration in the individual reports varied from 64% to 80%. Assessed by the classification of Zlotin, these values showed "high" taxonomic vicinity. Translated into ecological language this meant that the fungicide preparation did not affect the qualitative composition of the syrphid coenose.

For the entire period of study, four of the species – *M. corollae, S. scripta, E. arbustorum* and *E. tenax* were with the rank of permanent species. They were found at all readings of the fungicide's action.

Population density

In comparison with the impact of Vitra 50 HR on the qualitative composition of the syrphid complexes, the results of this survey showed a more significant influence of the preparation on the density of populations of the syrphid flies (Table 1). This impact was more expressed during the first three readings of the fungicide's action. Mitigation of the negative effects during the 10th day after the treatment was observed, which appeared in the increase of population density in relation to that recorded in the preceding days. The impact of the preparation appeared to be with a different force and duration in relation to the individual species. A major negative effect was accounted for the species *E. balteatus, S. scripta* and *P. podagratus*. In terms of the proximity between the syrphid complexes by population density in the area before and after the treatment, however, the results did not show great divergence. The similarity in density, determined by the coefficient of Jaccard-Naumov, was 48.1%, 55.2%, 60%, 74.2% and 67.6% respectively during the 1st, 3rd, 5th, 10th and 15th day. Only in the 1st day after the use of the fungicide, it was observed some difference in density of populations, but it was within the average values. In the other readings, proximity was "high".

The impact of the studied preparation on the individual species had also affected to some extent the overall density of the syrphid flies. Data for the total average density in the particular readings was set out in Figure 1.

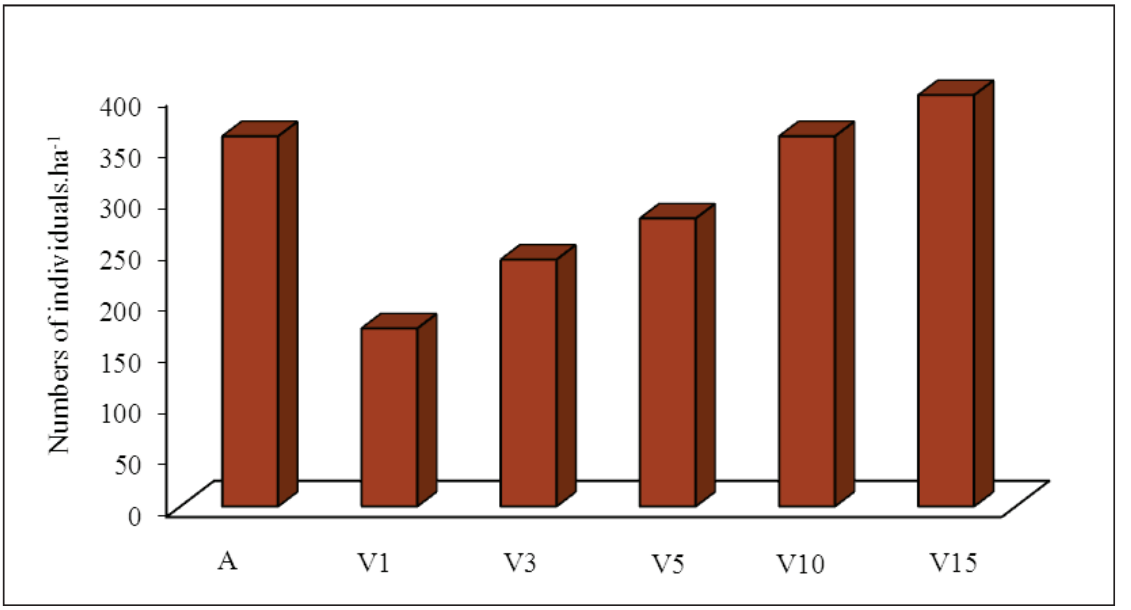

Fig. 1. Total density of the syrphid community
A – situation before the fungicide application;
V_1, V_3, V_5, V_{10} and V_{15} – situation respectively on the 1st, 3rd, 5th, 10th and 15th post-treatment day

The results showed that the fungicide preparation had a stronger negative impact on the total average density of the syrphid coenose only in the 1st day after the treatment, where the difference with the density of the non-treated area was 2.09 times lower and statistically validated ($P<0.05$). Up to the 5th day of recording, the density of the syrphid coenose remained lower than established in the non-treated area, but the difference was statistically unsubstantiated. After the 10th day of reading the total average density was already equalized and consequently higher than that prior the treatment, but the difference again remained statistically unsubstantiated.

Dominant structure

Effects of the fungicide preparation on the density of populations of the individual species gave some reflection on the dominant structure of the syrphid community (Table 1).

In principle, the dominant structure in poorer in species composition biocoenoses, as those in the agroecosystems, usually has been simplified. Such was the case with the studied syrphid biocoenose. Established species were only in the categories of dominants and subdominants. A similar fact was marked also in other studies of the effects of different plant protection devices (Markova and Dimcheva, 1998a; Markova and Ljubenova, 1998b; Markova, 2003; Markova, 2007; Markova and Teofilova, 2011).

The results from the particular readings showed that the impact of the used preparation affected primarily the number of dominant species. Evaluation of the taxonomic proximity between the complexes of dominants in the area before and after treatment with the fungicide however showed a lack of influence on the qualitative composition of the complexes of main species. The values of the taxonomic proximity index were 75%, 67%, 40%, 67% and 80% respectively during the 1st, 3rd, 5th, 10th and 15th day. Only during the 5th day after the use of the preparation an "average" difference with the dominant composition from the non-treated area was recorded.

Throughout the period of the study two of the species – *M. corollae* and *S. scripta* had the rank of dominant species in all of the readings, albeit with varying degrees of relative importance. Resistance of *S. scripta* in relation to different kinds of plant protection devices was shown also in other studies (Markova and Dimcheva, 1998a; Markova and Ljubenova, 1998b; Markova, 2003; Markova and Aleksiev, 2005; Markova, 2007; Markova and Teofilova, 2011).

Indexes of community structure

Indices for species structure of the communities, recommended by Odum (1975) and used in this survey, were sufficiently informative about the possible change of the environmental situation after the application of the fungicide preparation.

Data about the indices, adduced in the Table 1, made clear that the syrphid coenose was in some stress condition only during the first one to three days after the treatment with Vitra 50 HR. Under extreme conditions of the environment, it is observed increase of the numbers of a few more resistant to the changes species, which leads to augmentation of the value of the concentration of domination index. Simpson's index for concentration of domination (D) was greater in value from that in the non-treated area only during the 1st day after the use of the preparation. Other indices for species structure of the community alter in inverse proportion to the index for concentration of domination and in unfavorable ecological situation, their value is lower.

In this case the index of Pielou (e) was lower than that before the treatment only during the 1st day of reading, and the other two indices – for species richness of Margalef (d) and for a common species variety of Shannon-Weaver (Ħ) – showed lower values than those determined in the non-

treated area during the 1st and the 3rd day. Indices showed that the influence of the Vitra 50 HR fungicide on the syrphid coenose was low and relatively quickly surmounted. It might be noted, however, that in comparison with the Propiconazole fungicide (Markova and Teofilova, 2011), copper hydroxide containing Vitra 50 HR showed a little bit stronger negative reaction to the syrphid flies community.

Conclusion

The results of the presented study showed that the fungicide preparation Vitra 50 HR had a weak impact on the population and coenose parameters of the syrphid community only during the first one to three days after its application, and its action appears to be quickly surmounted.

Fungicide preparation of Vitra 50 HR was not only sufficiently effective against the phytopatogenes, but also was relatively tolerant to the beneficial components of ecosystems, which enhances its role as a plant protection product.

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