# EFFECTS OF THE PROPICONAZOLE FUNGICIDE ON THE STRUCTURE OF A SYRPHID COENOSE (DIPTERA: SYRPHIDAE)

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## ABSTRACT

This study was the first research of the effect of the fungicide Propiconazole (in the form of preparation "Bamper 25 EC", manufacturered by Makhteshim Agan – Izrael) on a structure of syrphid coenose (Diptera: Syrphidae). Effects of the fungicide preparation has been assessed on the basis of the common population and coenose parameters of the syrphid community in a wheat ecosystem: species composition, measured in terms of quantity and quality, density of populations of the different species, total average density of the community, dominant structure and species structure indices of the syrphid coenose.

The results showed that the Propiconazole fungicide did not have a negative influence over the syrphid coenose and it was compatible with the use of the syrphid flies as natural bioregulators of the density of a number of pests in agriculture.

***Key words:*** *Diptera, Syrphidae, community, fungicide, Propiconazole.*

## Introduction

One of the ways for reducing the negative impact of chemical resources for fight with cultural plants' pests and diseases on the environment is to search for strictly selective preparations, which maximum retain the beneficial components of ecosystems (Metyuz, 1987). This requires an active research work even after the official registration of the given preparation for plants protection (Medved, 1977).

## Material and methods

The study of the Propiconazole fungicide effects on the structure of the syrphid coenose was carried out in agricultural areas near the Tsaratsovo village, Plovdiv province, in wheat ecosystem. Fungicide was used in the form of preparation "Bamper 25 EC" on an area of 4 ha in order to combat the black rust on wheat.

The study was conducted from 26 May to 26 June in year 2008. The preparation was used in dose 50 ml/dka during the wheat blooming. Spraying with the fungicide was accomplished with an ordinary terrestrial agricultural technique on 27 May 2008.

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 enthomological sack with a diameter of 30 cm. Generally 8 samplings were committed.

The first material collection was carried out on the day immediately before the crop treatment – 26 May. The effects of fungicide were assessed consistently on 28 May, 30 May, 1 June, 6 June, 11 June, 16 June and 26 June, i.e. during the 1-st, 3-rd, 5-th, 10-th, 15-th, 20-th and the 30-th day after the treatment. In any of the material collections 50 samples were taken. Each sample represented 50 swaths with the enthomological sack with average length of one swath – 1 m. Collection of the material was carried out in similar weather conditions before noon, in warm, dry and quiet time.

To assess the impact of the fungicide on taxonomic composition of syrphids and on the complex of dominant species, 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 the Gilyarov (1974).

Data about total average density was processed in the generally accepted statistical variation methods. The similarity in the density of population was determined by the index of Jaccard-Naumov (Chernov, 1975). Dominant structure of the community was defined according to the classification of Arzamasov et al. (Hotko et al., 1982).

Ecological parameters recommended by Odum (1975) have been used for analysis of the species structure of the community – Simpson's index for concentration of domination (D), Margalef's index for species wealth (d), Shannon-Weaver's total species diversity index (H). The same indices were used also for assessment of the ecological status of the environment.

## Results and discussion

### Species composition

During the investigation the total of 12 syrphid flies species were established, of which 8 species from the Syrphinae and 4 species from the Milesiinae Subfamily (Peck, 1988). All found species fulfil an important ecological role – some of them are natural regulators of the density of many pests, and the others are of significance for the implementation of the substances circuit in nature.

The data about the syrphid species in the individual samplings and their density (number of individuals/ha) were presented in Table 1.

**Table 1.** Established species and their density (number individuals/ha) in the field before (A) and after (P) Propiconazole application

| Species | Density (number individuals/ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | P | | | | | | |
| | 26.05 | 28.05 | 30.05 | 01.06 | 06.06 | 11.06 | 16.06 | 26.06 |
| *E. balteatus* (De Geer) | 53 | 40 | 40 | 27 | 53 | 27 | 53 | 40 |
| *S. rueppelli* (Wied.) | 40 | 40 | 40 | - | 40 | - | 27 | 13 |
| *S. scripta* (L.) | 106 | 80 | 67 | 67 | 67 | 93 | 80 | 93 |
| *M. mellinum* (L.) | - | 13 | 53 | 40 | 40 | 27 | 27 | 40 |
| *P. albimanus* (Fabr.) | - | - | - | - | - | 27 | - | - |
| *P. tibialis* (Fall.) | 27 | 27 | 40 | 40 | - | 27 | 53 | 40 |
| *P. albifrons* (Fall.) | 13 | - | - | 27 | - | - | - | - |
| *P. bicolour* (Fabr.) | 13 | - | - | 13 | 40 | 13 | - | 13 |
| *E. arbustorum* (L.) | - | 40 | - | - | 27 | 27 | 13 | 40 |
| *E. pratorum* Meig. | - | - | - | 27 | 13 | - | 13 | 13 |
| *E. tenax* (L.) | 27 | 27 | 27 | 40 | - | 67 | 53 | 53 |
| *S. pipiens* (L.) | 53 | 40 | 53 | 40 | 53 | 67 | 53 | 40 |

The results of the study showed that the Propiconazole fungicide had a negligible impact over the number of species. The only reduction of number of species was recorded on the 3th day after the treatment, when the number of species was reduced with one species (the reduction was 12.5%) compared to the non-treated area. In the other cases, the number of species was either unchanged or higher than that found in the non-treated area. The result significantly differed from the situation when many other plants protection means were used, when a strong and prolonged pesticide effect on the number of species was established (Markova, 1997**;** Markova, Dimcheva, 1988).

The taxonomic similarity, which represented the closeness between the species composition in the area before the use of fungicide and after its application, also showed lack of influence of the fungicide preparation on the qualitative composition of the syrphid complexes. In the individual samples taxonomic similarity ranged from 45% to 70%. Assessed by the classification of Zlotin (1975) these values showed "average" and "high" taxonomic vicinity. In the ecological sense the recorded values showed a negligible difference or the absence of such with the species composition

in the non-treated area, i.e. fungicide did not affect the qualitative composition of the syrphid coenose.

For the entire period of study three of the species – *E. balteatus*, *S. scripta* and *S. pipiens* had the rank of permanent species. They were found at all readings of the fungicide working.

**Population density**

The results of the study showed that the Propiconazole furgicide had ambiguous, but relatively low affection on the density of the syrphid flies (Table 1). More significant negative impact was determined upon the species *P. albifrons* and *P. bicolor*, once established in the area before the treatment, and again found in the samples in the 5th day after the use of the preparation. Less was the affection upon the species *E. balteatus*, *S. scripta* and *S. pipiens*, where a reduction of their populations density was observed. Unaffected by the impact of the fungicide remained species *S. rueppelli*, *P. tibialis* and *E. tenax*. Positive effect was found for the species *M. mellinum* and *E. arbustorum*, which were established after the application of the fungicide.

The similarity in population density, determined by the coefficient of Jaccard-Naumov, followed the trend of the taxonomic similarity index. Similarity ranged from 47.1% to 65.5%, i.e. again from "medium" to "high".

Effects of the Propiconazole on the density of individual species were reflected to some extent on the total average density of the syrphid community, but that influence was also weakly manifested.

The total average density of the syrphid community in the area before the treatment was 333 ± 61 ind./ha. After the treatment the density during the 1-st and 3-rd day of the analyzing of the fungicide effects (respectively 307 ± 61 ind./ha and 320 ± 64 ind./ha) was 1.1 and 1.01 times less in comparison with that in the non-treated area. Differences in density, however, were statistically unconfirmed. During the 5-th day of recording, the density has been restored to the initial value, and in the all other cases of readings until the end of the research period, there was obsevred an increase of the total density. During the 30-th day density was 387 ± 64 ind./ha (1.16 times higher than the initially estimated). Differences, however, were also statistically unproved.

**Dominant structure**

There was a different influence of studied fungicide on the density of the populations of the species. It was reflected to some extent on the dominant structure of the syrphid community (Table 2).

**Table 2.** Dominance (relative significance, %) and some basic cenotic parameters of the syrphid community in the field before (A) and after (P) Propiconazole application; S – number of species, for other abbreviations – see Material and methods

| Species | A | P | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **26.05** | **28.05** | **30.05** | **01.06** | **06.06** | **11.06** | **16.06** | **26.06** |
| *E. balteatus* (De Geer) | 16.0 | 13.0 | 12.5 | 8.4 | 15.9 | 7.2 | 14.2 | 10.4 |
| *S. rueppelli* (Wied.) | 12.1 | 13.0 | 12.5 | - | 12.0 | - | 7.3 | 3.4 |
| *S. scripta* (L.) | 31.9 | 26.2 | 20.9 | 20.8 | 20.1 | 24.8 | 21.6 | 24.1 |
| *M. mellinum* (L.) | - | 4.2 | 16.6 | 12.5 | 12.0 | 7.2 | 7.3 | 10.4 |
| *P. albimanus* (Fabr.) | - | - | - | - | - | 7.2 | - | - |
| *P. tibialis* (Fall.) | 8.1 | 8.8 | 12.5 | 12.5 | - | 7.2 | 14.2 | 10.4 |
| *P. albifrons* (Fall.) | 3.9 | - | - | 8.4 | - | - | - | - |
| *P. bicolour* (Fabr.) | 3.9 | - | - | 4.0 | 12.0 | 3.4 | - | 3.4 |
| *E. arbustorum* (L.) | - | 13.0 | - | - | 8.1 | 7.2 | 3.5 | 10.4 |
| *E. pratorum* Meig. | - | - | - | 8.4 | 4.0 | - | 3.5 | 3.4 |
| *E. tenax* (L.) | 8.1 | 8.8 | 8.4 | 12.5 | - | 17.9 | 14.2 | 13.7 |
| *S. pipiens* (L.) | 16.0 | 13.0 | 16.6 | 12.5 | 15.9 | 17.9 | 14.2 | 10.4 |
| **D** | 0.1840 | 0.1531 | 0.1528 | 0.1296 | 0.1424 | 0.1531 | 0.1403 | 0.1344 |
| **H** | 0.8106 | 0.8576 | 0.8299 | 0.9176 | 0.8695 | 0.8784 | 0.8932 | 0.9284 |
| **d** | 2.1747 | 2.2325 | 1.8888 | 2.4853 | 2.1747 | 2.4008 | 2.4008 | 2.6728 |
| **S** | 8 | 8 | 7 | 9 | 8 | 9 | 9 | 10 |

Dominant structure of the community in the agroecosystem was relatively simplified. Species from the categories of recedents and subrecedents were not established. This fact is typical for relatively poor biocoenoses, in principle such as the agrocoenoses, and it is also marked in other similar researches (Markova, Ljubenova, 1998; Markova, Dimcheva, 1998; Markova, 2003, 2007). Dominant taxa (with relative significance ≥ 10 %) in the individual readings were the species *E. balteatus, S. rueppelli, S. scripta, M. mellinum, P. tibialis, P. bicolor, E. arbustorum, E. tenax* and *S. pipiens*.

The results of the study showed that in terms of the taxonomic composition of dominant species there were not significant changes noticed in the various readings. That was confirmed also by Jaccard's coefficient, used for assessment of the taxonomic proximity between the complexes of dominant species in the area before the treatment and after the use of Propiconazole. The values of the taxonomic proximity index were 80%, 67%, 29%, 67%, 40%, 43% and 38% respectively during the 1-st, 3-rd, 5-th, 10-th, 15-th, 20-th and the 30-th day after the treatment. More significantly changed in relation to the non-treated area was only the complex of dominant species during the 5-th day of the Propiconazole operation investigation. In the other cases there was no difference in the taxonomic composition of the dominant species after the use of the fungicide (during the 1st, 3rd and 10-th day) or the distinction was insignificant (in the 15-th, 20-th and 30-th day).

Throughout the period of the study two of the main species – *S. scripta* and *S. pipiens* retained their rank of dominants in all of the readings, although with a different relative importance. Resistance of *S. scripta* against various plants protection agents was also reported in other similar studies (Markova, Ljubenova, 1998; Markova, 2003, Markova, Aleksiev, 2005; Markova, 2007).

**Indices for species structure of the community**

Used indicators of the community species structure represented a numerical expression of the ecological conditions in the studied agroecosystem (Table 2). It was quite clearly seen from the table data that the environmental situation in the area after the fungicide treatment was not worsen. The values of the indicator of Simpson (D) in the treated area remained lower in comparison with that in the non-treated until the end of the investigation period.

In all readings after the treatment with the Propiconazole fungicide, data for the index of Shannon-Weaver (H) also showed very favourable conditions for the syrphid coenoses (the values of H were higher than those established in the non-treated area). In the conducted survey, only during the 3th day after the treatment, Margalef's index of species wealth (d) was lower than that found in the area before the use of Propiconazole, i.e. only during this day of the monitoring there were some deteriorations of the environmental conditions. In all other readings, high values of the species wealth index of Margalef (d) illustrated favourable for the syrphid coenose environmental characteristics.

**Conclusions**

The results obtained in the study showed that the environmental situation in the area after the use of the fungicide preparation did not register any deterioration in the conditions for the syrphid community.

The Propiconazole fungicide had no negative effects and it was compatible with the use of the syrphid flies as a natural bioregulators of the density of a number of pests in the agriculture.

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**REFERENCES**

1. Chernov, J. I., 1975. Fundamental synecological characterizations of the soil invertebrates and methods their analysis. - In: Methods of soil-zoological investigations, M., Nauka, 198-216. (In Russian).

2. Gilyarov, M.C., 1974. Study on the invertebrates as a biogeocoenological components. – In: Dilis, N. V. (ed.): Program and methods of biocoenological investigations, M., Nauka, 181-194. (In Russian).

3. Hotko, E. I., S. N. Vetrova, A. A. Matveenko, P. S. Choumakov, 1982. Soil invertebrates and industrial contaminations, Minsk, Nauka i tehnica, 265 pp.(In Russian).

4. Markova, E., 1997. Syrphud flies in natural grass ecosystems of some areas of Kraishte region (Bulgaria), Spixiana, 20, 1, 73-79.

5. Markova, E., 2003. Influence of the herbicide 2.4-D on the structure of the syrphid coenosis (Syrphidae, Diptera) in a barley ecosystem, Ann. Sofia Univ., Fac. Biol., Book 1 – Zool., 93-94, 117-124.

6. Markova, E., 2007. Influence of the herbicide tribenuron-methyl on the structure of the hoverfly community (Diptera: Syrphidae) in a wheat ecosystem, Acta zool. bulg., 59(2), 173-179.

7. Markova, E., A. Aleksiev, 2005. Influence of the synthetic pyretroid deltametrin on the syrphid community (Syrphidae, Diptera) in an oats ecosystem, Journ. of Balkan Ecology, 8, 3, 283-290.

8. Markova, E., P. Dimcheva, 1988. Influence of the phosphororganic insecticide chlorpyrifos on the structure of the syrphid coenosis (Syrphidae, Diptera) in a cabbage ecosystem, Acta ent. bulg., 2- 4, 37-43.

9. Markova, E., E. Ljubenova, 1998. Influence of the synthetic pyretroid insecticide alpha-cypermethrin on the structure of the syrphid coenosis (Syrphidae, Diptera) in a potato ecosystem, Journ. Appl. Entom., 122, 469-473.

10. Medved, L.I., 1977. Manual of pesticides, Kiev, Urozhai, 374 pp. (In Russian).

11. Metyuz, D. A., 1987. Insect pest control on the agricultural plants, M., Agropromizdat, 204 pp.(In Russian).

12. Odum, J., 1975. Fundamentals of ecology, Philadelphia-London-Toronto: W.B. Saunders company, 740 pp.

13. Peck, L. V., 1988. Syrphidae. – In: Catalogue of Palaearctic Diptera, Acad. Kiado, Budapest, 8, 8- 230, 320-363.

14. Wallwork, J., A., 1976. The distribution and diversity of soil fauna, London, Acad. Press, 355 pp. Zlotin, R. I., 1975. Life in high mountains, M., Misl, 227 pp. (In Russian).