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# INFLUENCE OF THE PHOSPHOORGANIC INSECTICIDE PHENITROTHION ON THE STRUCTURE OF THE SYRPHID COENOSIS (SYRPHIDAE, DIPTERA) IN A ROOT ZONE OF A BEET ECOSYSTEM


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## ABSTRACT

Markova, E. (1996), Influence of the phosphoorganic insecticide Phenitrothion on the structure of the syrphid co enosis (Syrphidae, Dipteia) in a beet root ecosystem. Ekol. Zašt. Život. Sred., Vol. 4, No 1, Skopje,

The effect of the phosphoorganic insecticide phenitr othion on basic population and coenotronic parameters of the structure of the syrphid community was studied in a field experiment.



**Key words:** *Syrphidae, Diptera,* coenosis, species composition, population density, dominantstracture,



## ИЗВОД

Маркова, Е (1996) Влијание на фосфоорганскиот инсектицид Фенитротион на структурата на сирфидните ценози (Syrphidae, Diptera) во кореновата зона на екосистем со репа. Екол, Зашт. Живог. Сред., Том 4, Бр. 1, Скопје.

Во трудот се се изложени проучувањата на теренските истражувања на ефектот на фосфоорганскиот инсектицид фенитротион врз основната популација и ценотички параметри на структурата на сирфидната заедница.



**Клучни зборови**: *Syrphidae, Diptera,* ценоза, видов состав, густина на популација, доминантна структура.


## INTRODUCTION

Despite their negative sides, the chemical methods in the straggle against pests, deceases and weeds of plants (Chalmers 1970; Миланова 1973; Мельников 1073; Graham-Bryce 1977; Медведь 1977; Sohrmann 1978) are still in use. That is why one of the major problems of plant defense is the searching for chemical preparations, which, to the greatest extent, preserve the necessary components of the ecosystems. The lack of sufficient data about the effect of the most of the pesticides on the useful bioagents in nature (predators and parasites) becomes more sensible and makes such investigations rather modern and necessary. This is the aspect in which the influence of pesticides on the representatives of the family *Syrphidae* should be discussed. These flies are some of the most important natural bioregulators of the population density of many pest species in agriculture. In Bulgarian syrphid literature these problems have been treated only in some single papers (Григоров 1981; Радева 1964; Маркова 1993).

In the available literature, there is not a lot of information about the influence, especially of the phrenitrothion, on the useful fauna (Gorecki 1973; Hamed et al, 1973; Kevan 1975; Bacilek 1982). The only study which treats the effect of phenitrothion especially on syiphid flies is this of Ekbom (1985). The author has established a lower number of syrphid lar vest in the area cropped with summer bailey, and treated with phenitrothion in comparison with untreated area.

The present study is the first one aiming the analysis of the effects of phenitrothion on the basic population and coenitic parameters of the struc-

tare of the syrphid community: species composition, population density, total numerical strength, dominance.

## MATERIAL AND METHODS

The Bulgarian preparation" Agria 1050" was used. It consists of 50% phenitrothion (-0,0-dimethyl-0-(3-methy1-4-nitiophenil)-phosphothyoate), emulsifier and organic solvents. Phenitrothion is a chloroganic insecticide with broad specter of actions. It is applied in the struggle against sucking and grazing insects, as well as against plant-eating acres (Медведь 1977). It expresses a contact and stomach action with a quick initial effect and a comparatively long post-action.

The influence of the preparation was studied in a field experiment in 1993 in the town of Bjala, on an area of 40 ha cropped with beet-root, var. "Hemus" during the period of growing of the tubers. The preparation was used in the struggle against *Mamestra brassicae* L. The beet-root culture was treated on 27.07.1993 with a dosage of 2 $l.ha^{-1}$ and concentration of the solution 0,6% The influence of the preparation over the syrphid coenosis was assessed on 28.07., 31.07., 4.08., 11 08., and 27.08,1993. The samples were collected by the method of "mowing" with a standard entomological sack (d=0.30 m) six times - during the day just before the treatment with the preparation and on the first, fourth, eighth, fifteenth and thirty-first day after the treatment. At every "mowing" 50 samples were collected, each consisting of 50 mowing (average lenght of the mowing - 1 m). The changes in the quality of the whole syrphid complexes before and after the application of the preparation, as well as the complexes of the basic species were calculated through the Jaccard index (after Wallwork 1976), and were assessed according to the 5-grade classification of Злотин (1975) The population of density of every species was calculated after the method recommended by Гиляров (1974), and the data about the total number do the syrphid flies were statistically processed by the method of dispersion analysis according to the algorhitms of Плохинский (1970). For the assessment of the total biocoenotic similarity - the Veinstein's index (after Чернов 1975). The hanges in the dominant structure were classified according to Арзамасов et al, (after Хотько et al. 1982) For the analysis of the species structure of the syrphid co enosis were used the Simpson's index of concentration of domination (D), Margalef s index of species abundance (d), Pielou's index of equality (E) and Shannon's index of total diversity (H) (after Одум 1975).

## RESULTS AND DISCUSSION

The influence of phenitrothion on the species content was negative and distinctly expressed, The established species and their number in the studied area before and after the treatment with the preparation are given in Table 1 After the application of the insecticide a considerable decrease of the number of species established in the not-treated area was found, The decrease rates 50%, 67%, 50%, 33% and 17% respectively on the first, fourth, eight, fifteenth and thirty-first day after the treatment. Till the end of the investigation, i.e. up to the thirty-first day of the assessment of the phenitrothion influence, the initial number of species was not restored After the application of the pesticide two of the species completely droped off.

Tab. 1 Established species and their numbers (number individuals per ha) in the area before (A) and after the treatment with the phenitrothion preparation (P)

Таб. 1 Утврдени видови и нивната бројност (број на индивидуи на ha) во површината пред (A) и по третман со препаратот фенитротион (P)

| Species \ видови | Number individuals per ha / број на индивидуи на ha | | | | | |
|---|---|---|---|---|---|---|
| | A | P | | | | |
| | 26.07. | 28.07. | 31.07. | 04.08. | 11.08. | 27.08.1993 |
| *Episyrphus balteatus* (Deg.) | 53 | - | - | - | - | - |
| *Metasyrphus corollae* (F.) | 107 | 27 | - | 67 | 40 | 133 |
| *Scaeva pyrastri* (L.) | 27 | - | - | - | - | - |
| *Sphaerophoria scripta* (L.) | 227 | 133 | 147 | 133 | 200 | 173 |
| *Syrphus ribesii* (L.) | - | - | - | - | - | 27 |
| *Melanostoma mellinum* (L.) | 147 | 107 | 120 | 133 | 173 | 173 |
| *Syritta pipiens* (L.) | 27 | - | - | - | 40 | 53 |

The application of the insecticide caused changes in the quality content of the syrphid coenosis, although not a such high extent as was the case with the number od species. The similarity of the taxonomic content of the studied area before and after the treatment with the poreparation was 50, 33, 50, 67, 57% respectively for the first, fourth, eighth, fifteenth and thirty-first day of the taxonomic similarity index proved formation of a significantly different syrphid complex with the one in the not-treated area. During the rest of the experiment the syrphid complexes did not differ at all or were quite close to the complex before the phenitrothion application.

The negative influence of phenitrothion on the syrphid flies was expressed most strongly in the numerical strength of their species (Tab. 1). Although the sensibility of every species was not equal, respectively the influence of the preparation was different in strenght, too, the effect of the insecticide was considerably strong and negative In some of the species *(E. balteatus, S. pyrastri)* the reaction was so strong, that after the application of the insecticide they were not established anymore till the end of experiment. The population density of the rest of the species was lowered from 10 to 63% compared to the values from the not-treated area. Only the fifteenth and after that on the thirty-first day of the application of the preparation an increase of the population density was registered-for two of the species on the fifteenth day with 19, 19, and 49% respectively. On the thirty-first day of assessment a new species, *S. ribesii*, was established.

These numerical relations reflected on the similarity of the population density in the studied area before and after the treatment with phenitrothion The similarity compared to the not-treated area for the first and fourth day of the experiment was mean (40 and 46% respectively) and high on the eighth, fifteenth and thirty-first day (57, 66 and 65% respectively). Totally for the whole period of investigation, the similarity was low - 26%.

The general biocoenotic similarity was low if compared to the values from the not-treated area on the first, fourth, eighth day after the application of the preparation (23.15 or 29%), and mean on the fifteenth and thirty-first day (44 or 37%) of registration. Throughout the whole period of investigation the parameter of biocoenotic similarity proved to be quite low - 15%.

The abrupt negative effect of phenitrothion on the numerical strength of the populations of every species immediately after its application reflected in the total mean density of the syrphid flies as well (Fig. 1) The strongest and mathematically proved (P=0.99) was the phenitrothion effect on the first, fourth and eighth day after using preparation. On the fifteenth day after the treatment this influence was statistically insignificant and remained such till the end of the investigation. The mean density of the syrphid flies throughout the whole period of study after the application of phenitrothion was proved (P=0.95) to be with 36% lower than this in the untreated area.

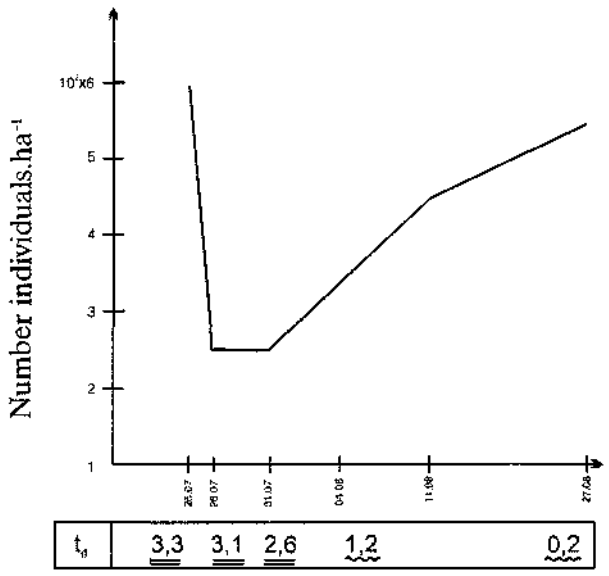


Fig. 1 Influence of the phenitrothion preparation on the total density of the syrphid flies.
Сл. 1 Влијание на препаратот фенитротион на вкупната густина на сирфидните муви.

The influence of phenitrothion was expressed to a certain extent in the total dominant structure of the syrphid coenosis. Its strong effect on the numerical strength of the syrphid population, however did not lead to considerable changes in the numerical ratios between species, thus the content of the basic species within the complexes was preserved approximately one and the same (Tab. 2).

Tab. 2 Basic species (with dominant index ≥10%) in the area before (A) and after the treatment with the phenitrothion preparation (P)

Таб. 2 Основни видови (со индекс на доминација ≥10%) во површината пред (А) и по третманот со препаратот фенитротион (П)

| Species/видови | Dominant indexes/индекси на доминација | | | | | |
|---|---|---|---|---|---|---|
| | A | P | | | | |
| | 26.07. | 28.07. | 31.07. | 04.08 | 11.08. | 27.08.1993 |
| *Metasyrphus corollae* (F.) | 18.2 | 10.0 | - | 20.0 | - | 23.8 |
| *Sphaerophoria scripta* (L.) | 38.6 | 50.0 | 55.0 | 40.0 | 44.1 | 31.0 |
| *Melanostoma mellinum* (L.) | 25.0 | 40.0 | 45.0 | 40.0 | 38.2 | 31.0 |

The similarity between the complexes of the basic species in the area after the treatment with the insecticide on the first, fourth, eighth, and thirty-first day od investigation was absolute. During the rest days of assessment, the similarity was high - 67%.

Common dominant species throughout the whole period of investigation were *S. scripta* and *M mellinum.* The changes in the numerical strength of every species as a result of the treatment with phenitrothion more considerably reflected in the subdominants. In the studied area before the treatment there were 3 subdominant species - 18.3%. On the first, fourth, and eighth day after the application of the insecticide subdominants were not registered. On the fifteenth, and thirty-first day of the investigation 2 subdominant species were registered at every count and they accounted respectively for 17.6& and 14.3% from the total number of species.

The presence of considerably negative influence of phenitrothion on the species structure of the syrphid coenosis was confirmed by the analysis of the following parameters H, E, D and d (Fig 2) The higher values of the parameter of the concentration of domination, D, after the application of the insecticide undoubtedly proved that the syrphid coenosis was in state of stress from the very beginning of the application of phenitrothion till the end of the experiment, The parameter D on the first, fourth, eighth, fifteenth, and thirty-first day of registration was respectively 1.6, 2.0, 1.4, 1.4, and 1.0 times higher than it was before the treatment Most unfavorable for the syrphid files proved to be the ecological situation on the fourth day after the application of the insecticide.

The parameters of species diversity H and d are a numerical expression of the ecological rule that in unfavorable conditions of the environment the number of species is higher and their numerical strength is lower. The species diversity is higher in the ecosystems controlled by biological factors, and insignificant in the ecosystems which strongly depend on the limiting physical-chemical factors (Одум, 1975). In this aspect the parameters H and d independently from their comparatively not very high values proved worse ecological conditions, caused by the influence of phenitrothion

Logically it should have been expected that in the studied area after the treatment with the insecticide the equality index of Pielou (E) would get lower to a certain extend Actually, the data from the current investigation were opposite - the parameter was lower in the area before the application of the insecticide The pesticide stress was expressed by the equality index although this expression was weak and registered only on the fifteenth day of assessment. This situation was a case which could be frequently observed in stressed coenosis with comparatively poor species content with domination of only few species, i.e. at stressing coenosis, which actually were in stress conditions already. At such a similar second stressing according to Odum (1975) most frequently the species content does not change, and the numerical strength of the dominant species decreases, which leads to a higher equality.

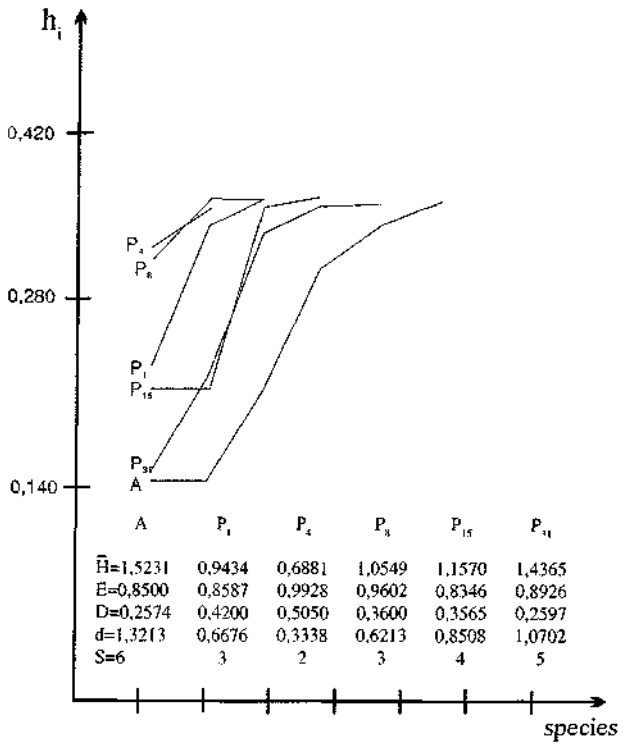


Fig. 2 Structure of domination and some ecological parameters of the complex of syrphid flies
Сл. 2 Структура на доминација и некои еколошки параметри на комплексот на сирфидните муви

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# ВЛИЈАНИЕ НА ФОСФООРГАНСКИОТ ИНСЕКТИЦИД ФЕНИТРОТИОН НА СТРУКТУРАТА НА СИРФАДНАТА ЗАЕДНИЦА (SYRPHIDAE, DSPTERA) ВО КОРЕНОВАТА ЗОНА НА ЕКОСИСТЕМ СО РЕПА

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**РЕЗИМЕ**

Во оваа студија се проучувани влијанието на инсектицидот фенитротион врз природните популации и ценотичките параметри, како и структурата на сирфидната заедница: видов состав, густина на популација, доминација итн..

Влијанието на фенитротионот беше негативен како во однос на густината на популацијата на секој вид одделно така и во однос на вкупната бројност на сирфидните муви. Најсилен и статистички потврден (P=0,99) беше ефектот на фенитротионот во првиот, четвртиот и осмиот ден на апликација на препаратот, кога вкупната бројност беше соодветно 2,2; 2,2 и 1,8 пати помала во споредба со состојбата пред третманот со инсектицидот.

Исто така, присуството на очекуваното негативно влијание на фенотротионот врз сирфидите беше потврдено и преку параметрите за структурата на видовите.

Добиените резултати недвојбено покажуваат дека препорачаните дози на инсектицидот, употребени во борба против штетниците во земјоделството имаат силен негативен ефект врз сирвидите.