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THE EFFECT OF ACTELLIC EC 50 ON THE CARABIDAE AND STAPHYLINIDAE IN A NORWAY SPRUCE FOREST IN THE JIZERSKÉ HORY MOUNTAINS

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The first observation of two model groups of insects carried out during the application of Actellic EC 50 against *Zeiraphtera diniana* indicated a large affection of various *Diptera* and *Coleoptera* by this insecticide. The present analysis of *Carabidae* and *Staphylinidae* communities in the treated and untreated forests shows that both families remained intact due to the hidden kind of life of majority of species. This conclusion is to be carefully considered and should not be generalized for other groups of Arthropods.

The control of *Zeiraphtera diniana by* Actellic EC 50 (2 l/ha) as carried out in the Jizerské hory mountains in the summer 1980, represents a rather heavy pressure against forest ecosystems. Large numbers of dead *Syrphids, Sarcophagids, Tipulids,* beetles and other insects were observed during or immediatly after the application of the insecticide. The aim of the present paper is to evaluate the effects of the control of *Zeiraphtera diniana* on the *Carabidae and Staphylinidae* in a Norway Spruce monoculture ecosystem near Hřebínek in the Jizerské hory mountains.

Material and methods

The *Carabidae* and *Staphylinidae* were collected in the pitfall traps with 2 % formalin solution. The traps were exposed in a transsect (fig. 4) crossing the stand in wich *Z. diniana* should be controlled and the neighbouring stand excluded from the control, one month before the pressumed control. On the day of the application of Actellic the beetles dropped into the traps were taken. Such samplings took place repeatably once a month till the end of vegetation period (fig. 5). The beetles taken into the individual traps were treated separately. The Sørensen's index of species similarity, Renkonen's index of dominance identity, Shannon's index of diversity (Schwerdtfeger, 1976) and index of occurence (IO) and index of occurrence intensity (IOI) (Jurík, Šustek, 1978) were applied for the evaluation of the material collected. For the evaluation of species spectrums in both stands studied the spe-

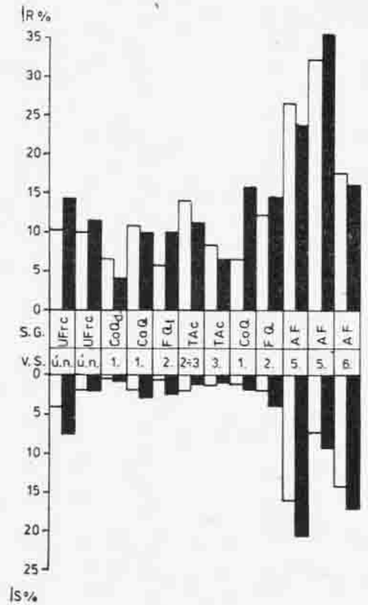

Fig. 1. Values of Sørensen's index (species similarity) and Renkonen's index (dominance identity) between *Carabidae* and *Staphylinidae* in stands studied (black columns = treated, white columns = untreated) when compared with their species spectra in various forest geobiocenoses (UFrc — *Ulmeto-Fraxineto carpineum*, CoQ d. = *Corneto-Quercetum*, degradation stadium, CoQ = *Corneto-Quercetum*, TAc = *Tilieto-Aceretum*, AF — *Abieto-Fagetum;* al. = aluvia of rivers; 1 = oak veg. tier, 2. = beech-oak veg. tier, 3. = oak-beech veg. tier, 5. = fir-beech veg. tier, 6. = spruce-fir-beech veg. tier, V. T. = vegetation tier, G. G. = group of geobiocenoses).

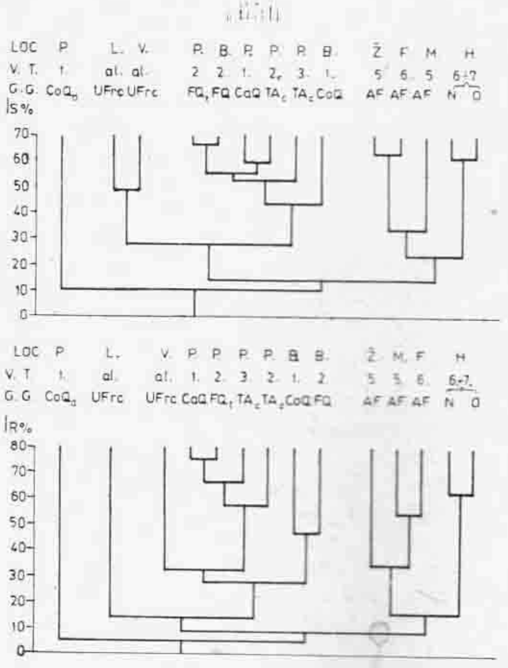

Fig. 2. Dendrograms of Sørensen's and Renkonen's indices between *Carabidae* and *Staphylinidae* in both stands studied and in geobiocenoses compared (Loc. = locality, P = Pavlovské kopce hills, V = Vranovice, L = Lednice, B = Boleradice, Ž = Žákova hora hill, F = Františkova myslivna hill, M = Mrhatina hill, H = Hřebínek elevation point; other abbreviations as in fig. 1).

cies spectrums from several natural forest geobiocenoses of Moravia (Š u s t e k, 1976, thesis) were used. The similarity of spectrums compared was evaluated by the use of cluster analysis (L e u s c h n e r, 1974). weight average linkage method).

The stands of Norway Spruce *(Picea excelsa)* selected for study were situated in a flat plateau at the elevation of 1020 m, about 200 south from the elevation point Hřebínek. The untreated stand consisted of about 15 m high Norway Spruce monoculture without herbage stratum. The height of the stand reached about 20 m on the margin of a forest way (fig. 4) and there the herbage stratum, mostly *Vaccinium myrtillus*, was developed. The treated stand had the same character as the untreated one. Only a creek was running through its interior. Individual tress of *Alnus sp.* limited this creek (fig. 4). The herbage stratum consisting of *Vaccinium myrtillus* was developed only in the neighbourhood of the way. The reason for the selection of these two stands was the homogenity of stands, the identical elevation, the approximately identical height and density of tress and the neighbouring position in the plateau. So the maximum of factors possibly influencing the results was eliminated.

The materiál collected in both stands consists of 577 individuals belonging to 19 species of *Carabidae* and 152 individuals belonging to 17 species of *Staphylinidae*. The following five species of *Carabidae* and one species of *Staphylinidae were* dominant (more than 5 %) in both stands, viz. *C. sylvestris, C. linnei, T. pulchellus, T. cardioderus, P. unctulatus* and *Atheta sp.* The: *Carabidae C. mollis* and *N. biguttatus* and the *Staphylinide M. mulsanti* were *subdominant* (2—5 %) in the untreated stand. The *Carabidae C. auronitens, C. violaceus* and *A. assimile* and *Staphylinide O. angustatus* were subdominant in the treated stand. Other species (tab. 1) were represented only individually.

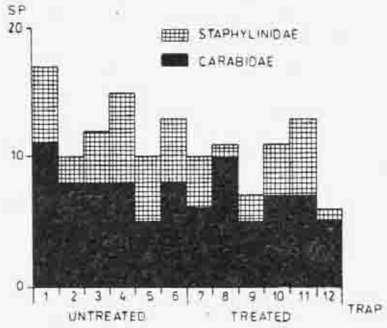

Fig. 3. Number of species in individual traps in threated and untreated stands.

Ecological and cenological characteristics of the material studied

As seen from figs. 1 and 2 the species composition is most similar to the compared natural Carabid and Staphylinid taxocenoses of the fir-beech vegetation tier (Z l a t n í k, 1966) and in the spruce-fir-beech vegetation tier of Moravia. The presence and a high abundance of *C. sylvestris, T. cardioderus* characteristic of the 6th and 8th veg. tiers and *T. pulchellus* and *C. linnei* distributed optimally in the 5th—7th veg. tiers on one hand and the absence or a very low abundance of *P. brumeisteri, C. auronitens, C. violaceus* reaching their optimal vertical distribution in beech (the 4th) and fir-beech (the 5th) veg. tier on the other hand are considered to be characteristic of the taxocenoses typical of the spruce (the 7th) veg. tier. The monocultural character of stands studied, the absence of herbage stratum, the covering of the soil by high stratum of decaying needle leaves is indicated by relatively high abundance of *N. biguttatus* and *C. mollis* which are characteristic of all coniferous monocultures in Central Europe.

The ecological diversity in both taxocenoses studied, expressed by the value of 3.08 bit and 2.90 bit respectively (tab. 1) is characteristic of the *Carabidae* and *Staphylinidae* communities of natural or little influenced forest ecosystems of similar elevations (Š u s t e k, P o v o l n ý, 1979).

The species spectrums in both stands are very similar to each other (fig. 2). The differences between them are due to the absence or presence of recendent (0.5—1 %) or influent (0.5 %) species characterized by low IO and IOI only. Their presence is partly occasional or it is caused by higher degree of humidity in the treated stand inhabited by some hygrophilous species, viz. *A. assimile* and *A. gracile*. The lower species and individual numbers in the treated stand are due to its isolation from the untreated one by a road and due to its surrouding by a large clearing. This factor, as shown by Š u s t e k (1981) can influence the population density in a relatively large distance from the stand margin into its interior. Considering all above facts, these taxocenoses do not appear to be influenced by such anthropic factors as pollution or pests control before the application of Actellic EC 50 against *Z. diniana*.

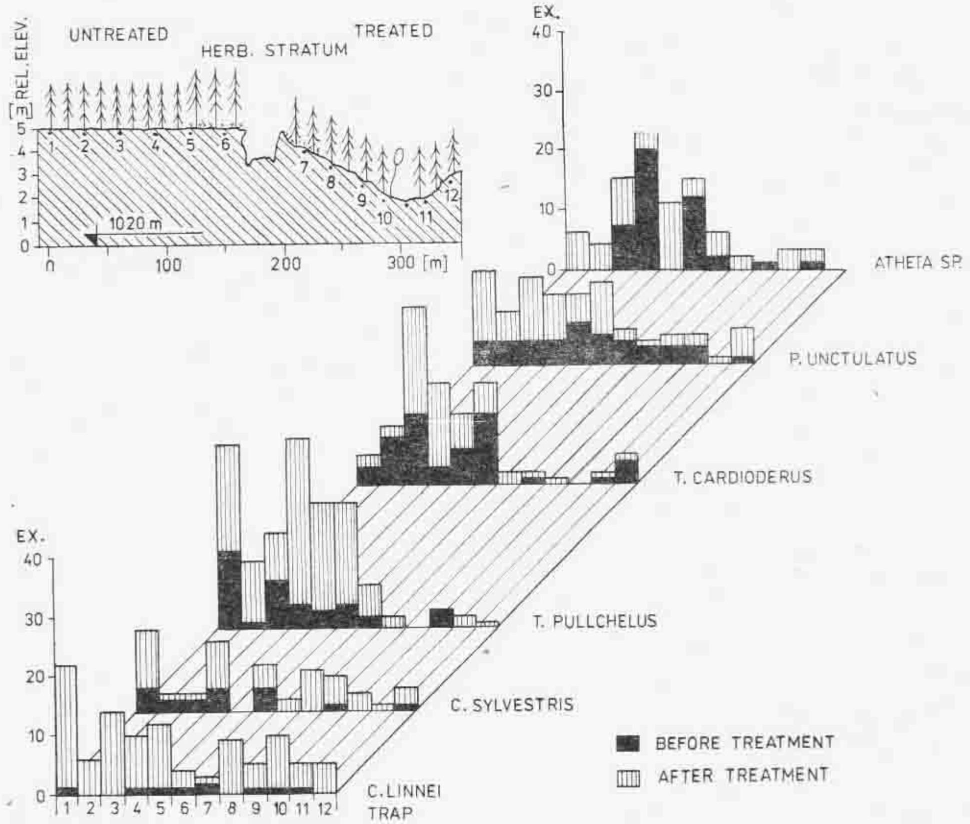

Fig. 4. Activity abundance of dominant species in individual traps before and after control of *Z. diniana* in treated and untreated stands.

Influence of the control of Z. diniana on the Carabidae and Staphylinidae

As seen from the fig. 3 the number of occurring species in both families declines from the trap No. 1 in the centre of untreated stand till the trap No. 12 in the treated stand. This would indicate a large influence of the treatment on both families, affecting them rather deeply on the untreated stand centre, too. Other results are seen from fig. 4 showing the abundance of dominant and constant species in the whole transsect. An analogical declining trend, as in fig. 3, is visible only in two species, viz. *C. linnei* and *P. unctulatus*. The abundances of other species, viz. *Atheta sp.*, *T. cardioderus*, *T. pulchellus* and partly of *C. sylvestris*, culminate in the traps No. 4 — 6 (fig. 4) on the border between both stands. The abundance of these species tends to get lower in both directions, viz. towards the centre of the untreated stand and towards the treated stand, as well. Such distribution of abundance corresponds any kind of focality of occurring species. This focality is evident from fig. 4 in both stands before and after the treatment, as well. A more exact analysis of this phenomenon would reveal that in the species of the same body size and occupying the same ecological niche and having the same trophical level (in the strict sense of word), the abundance

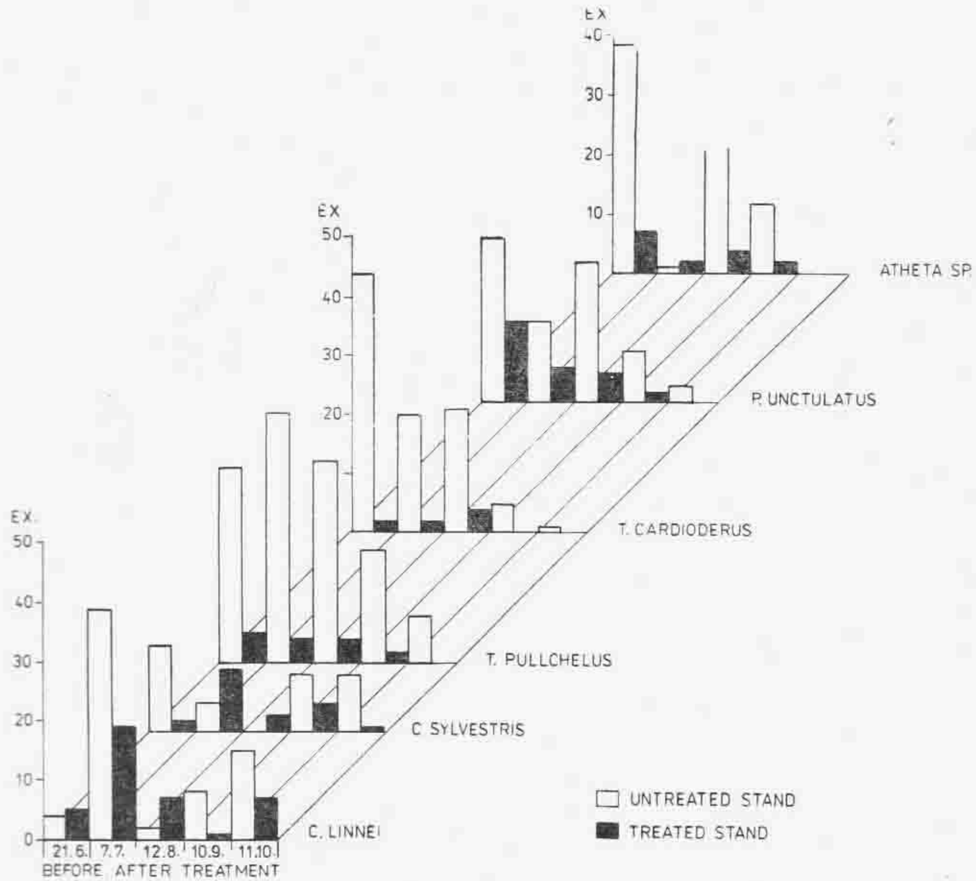

Fig. 5. Seasonal dynamics of activity abundance in dominant species in both stands; start of sampling 20. 5. 1980, finish 11. 10. 1980.

maxima of one species correspond to the abundance minima of the other, e. g. *T. pulchellus* — *T. cardioderus* (3—4 mm), *C. linnei C. syvestris* (12—17 mm). It is obvious that this phenomenon is caused by the competion pressure of two (or more) similar species as observed by other authors (in Thiele, 1977).

As seen from the fig. 5 the abundance of the individual species was much lower in the treated stand than in the untreated stand during the whole season. The relation between abundances in both stands was of the same character before treatment and after it as well. The maximum occurrence in majority of species and the folowing decline in their abundance (fig. 5) of June corresponds with the spring reproduction type (Larsson, 1939), to which all species presented in fig. 5 belong. The maximum abundance of *C. linnei* protracted to July and its second peak due to the folowing generation is visible in the autumn. An indication of this abundance dynamics type is visible in *C. sylvestris*, too.

From the facts above we may conclude that the control of *Z. diniana* by Actellic EC 50 did not affect the *Carabidae* and *Staphylinidae* taxocenoses visibly, as would be possibly pressumed at first adspective observations carried out immediately after

Table 1

Rewiev of species

Occuring species	Activity abundance		Untreated stand		Treated stand	
	C	T	IO	IOI	IO	IOI
Trechus pulchellus	132	15	22.0	22.0	2.5	3.0
Carabus linnei	68	39	11.3	11.3	6.5	6.5
Pterostichus unctulatus	78	27	13.0	13.0	4.5	4.5
Trechus cardioderus	91	8	15.2	15.2	1.3	1.5
Carabus sylvestris	40	23	6.7	8.0	3.8	3.8
Calathus mollis	13	1	2.2	2.2	0.2	1.0
Notiophilus biguttatus	13	1	2.2	2.2	0.2	1.0
Carabus auronitens	2	4	0.3	1.0	0.8	2.5
Leistus piceus	3		0.5	1.5		
Pterostichus burmeisteri	3		0.5	3.0		
Agonum assimile		3			0.5	1.0
Pterostichus aethiops	2		0.3	1.0		
Carabus violaceus		2			0.3	1.0
Trichotichnus laevicollis	1		0.2	1.0		
Cychrus rostratus	1		0.2	1.0		
Nebria brevicollis	1		0.2	1.0		
Carabus arcensis	1		0.2	1.0		
Agonum gracile		1			0.2	1.0
Pterostichus niger		1			0.2	1.0
Carabidae, number of indiv.	449	125				
Carabidae, number of species	15	12				
Atheta sp.	74	15	12.3	12.3	2.5	3.0
Mycetoporus mulsanti	22	1	3.7	5.5	0.2	1.0
Othius angustatus	2	4	0.3	1.0	0.7	0.8
Tachinus rufipes	6		1.0	6.0		
Bryocharis formosa	4	1	0.7	2.0	0.2	1.0
Lathrobium brunneum	3	1	0.5	3.0	0.2	1.0
Lesteva monticola	4		0.7	2.0		
Omalium rivulare	3	3	0.5	1.0	0.5	1.0
Rugilus rufipes	2	1	0.3	1.0	0.2	1.0
Quedius paradissianus	2		0.3	2.0		
Oxypoda sp.	1	1	0.2	1.0	0.2	1.0
Quedius ochripennis	1		0.2	1.0		
Ocypus picipes	1		0.2	1.0		
Anthophagus ovalis	1		0.2	1.0		
Lathrobium fulvipenne	1		0.2	1.0		
Xantholinus tricolor	1		0.2	1.0		
Omalium caesum		1			0.2	1.0
Carabidae, number of ind.	128	27				
Staphylinidae, number of spec.	16	9				
Total of individuals	577	152				
Total of species	31	21				
Ecological diversity indicated by negative enthropy (bit)	3.28	2.90				

the application of the insecticide mentioned. The differences observed between the both stands are caused probably only by non-anthropic factors. A larger number of species in the untreated stand was caused by the higher abundance of all species explained above causing a higher probability of their sampling.

Discussion

All analyses show conformly that the aviatic control of *Z. diniana* did not visibly effect the *Carabidae* and *Staphylinidae* populations. This fact contradicts considerably to the general predictions and direct observation during the application of Actellic or during a few hours after it. We should consider, when explaining this surprising phenomenon, that all forest inhabiting species of both families are nocturnous (only the *Notiophilus* species make the exception) mostly being hidden in litter, under stones etc. during the day. So they are protected against direct effect of insecticides during first hours after their application on the forest. Only the individuals occasionaly active are contacted by them during this period. Such instances are purely occasional or they are more regular during a raining period or under clouded sky and lower temperatures. So only a fraction of a population may be affected. Another factor limiting the efficacity of insecticide is the fact that a great deal of insecticide aerosol dispersed from the planes remains on the branches and needles of trees or on the herbage stratum respectively. There the insecticide is exposed to the effect of various plant surface substances, of oxidation, sun radiation etc. So it contacts *Carabidae* and *Staphylinidae* with a delay being washed by precipitations and inder the loss of effectivity. Another factor limiting the effectivity of insecticide is the air circulation which is rather intensive especially in the mountain conditions. Also a comparatively short period during which the intoxicated insects, above all the larvae of *Z. diniana*, dropped from the trees, indicates that the *Carabidae* and *Staphylinidae* were not affected in such a large scale as expected. This rather optimistic conclusion, however, should not be generalized. It must be considered that the *Carabidae* and *Staphylinidae* are rather resistant to several anthropis factors, as shown by several authors (T o p p, 1962; D a v i s, 1978; Š u s t e k, 1979, 1980; T h i e l e, 1977) in urban ecosystems and by M ü l l e r (1972) in the field ecosystems.

Conclusions

1. The species spectra in the stands studied correspond to the conditions of the spruce-fir-beech or spruce vegetation tiers and they are similar when compared with species spectra of natural forest geobiocenoses of the same of fir-beech veg. tiers in Moravia. The differences are due to the substitution of original geobiocenoses by coniferous monocultures and due to various tolerance or preference in relation to this change of habitat, in the individual species.

2. The differences between species spectra and abundances in individual species in treated and untreated stands are caused partly by a higher degree of soil humidity in the treated stand, and are partly due to its neighbourhood

with a large clearing, and due to its isolation from the untreated stand by an inside forest road, which made any exchange and migration of species between both stands difficult.

3. The distinctive focality is evident from the distribution of abundance in the individual species and in the individual traps. It was caused partly by the competition between the couples of species related systematically, ecologically and in their size.

4. The dynamics of abundance activity in the individual species correspond with a general scheme of life cycles in the so-called spring reproducing species. No visible insecticide effect could be observed in the both stands.

5. We may conclude from the present facts that several reactions of various *Diptera* and *Coleoptera* observed immediatly after the application of Actellic EC 50 are of a short duration and only parts of populations were affected, which were active in the air or on the soil surface. The greatest part of *Carabidae* and *Staphylinidae* populations being hidden in soil, under stones etc. during the day remained intact.

6. This rather optimistic onclusion must be carefully considered and cannot be generalized or applied to any other group of arthropods. The reasons for this careful consideration are following: the hidden kind of life during the day, the nocturnal activity and especially a high resistance to anthropogenous factors and pollution stated in both families by several authors studying the urban ecosystems.

Translated by author

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ÚČINOK PRÍPRAVKU ACTELLIC EC 50 NA CHROBÁKY ČEĽADÍ CARABIDAE A STAPHYLINIDAE V SMREKOVÝCH PORASTOCH JIZERSKÝCH HÔR

Zbyšek Šustek

Prvé pozorovania hmyzu v priebehu aplikácie prípravku Actellic EC 50 proti *Zeiraphtera diniana* naznačovali, že rôzne skupiny dvojkrídlovcov a chrobákov budú veľmi silne zasiahnuté týmto insekticídom. Rozbor spoločenstiev čeľadí *Carabidae* a *Staphylinidae* v ošetrenom a neošetrenom poraste ukázal, že tieto spoločenstvá neboli zasiahnuté týmto insekticídom pre skrytý spôsob života väčšiny druhov patriacich do týchto čeľadí. Tento záver sa však musí veľmi starostlivo uvážiť a nesmie sa zovšeobecňovať na iné skupiny článkonožcov, pretože obidve čeľade sú podľa viacerých autorov (Topp, 1972; Davis, 1978; Šustek, 1979; Müller, 1972) veľmi rezistentné voči antropogénnym vplyvom.

Došlo 10. 6. 1981

ДЕЙСТВИЕ ПРЕПАРАТА ACTELLIC EC 50 НА ЖУКОВ СЕМЕЙСТВ CARABIDAE И STAPHYLINIDAE В ЕЛОВЫХ НАСАЖДЕНИЯХ ЙИЗЕРСКИХ ГОР (JIZERSKÉ HORY)

Збышек Шустек

Первые наблюдения за насекомыми во время применения препарата Actellic EC 50 против *Zeiraphtera diniana* указывали, что разные группы двукрылых и жуков будут очень сильно затронуты этим инсектицидом. Анализ сообществ семейств *Carabidae* и *Staphylinidae* в насаждениях за которыми было ухаживано и тоже в насаждениях за которыми не было ухаживано показал, что эти сообщества не были затронуты упомянутым инсектицидом из-за скрытого способа жизни большинства видов относящихся к этим семействам. Правда, эти выводы надо очень серьезно оценивать и нельзя их обобщать для других груп членистоногих, потому что обеи семейства, по мнению многих авторов (Topp, 1972; Davis, 1978; Šustek, 1979, 1980; Müller, 1972) являются устойчивыми против антропогенных влияний.