Species diversity of insects in pear ecosystem in Băneasa-Bucharest

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Summary

The investigations were carried out in the chemical sprayed pear orchard of Researche-Development Institute for Plant Protection Bucharest in 2003, using the branch beating method. A total of 26031 individuals of insects were sampled, 22194 pest and 3837 beneficial insects. The pest entomofauna included 32 species with the dominance indices between 0.76-0.98 reached of pear psylla, the main pest of pears in Romania. The beneficial entomofauna included 48 species with the dominance indices between 0.34-0.71 reached of ants. They are attracted on the honeydew produced by psylla and aphid colonies. In the pest insect community, the species diversity showed higher values in April (1.46) and May (1.88) and strong decreased in June (0.8), July (0.49) and August (0.26). In the beneficial community, the diversity of species was the greatest in July (4.42) and August (4.68) and the lowest from April to June (1.66-2.59). Equitability indices values for beneficial populations increased to about 1, while that of pest populations decreased at levels of 0.29 and 0.18 in July and August.

Keywords: *Pyrus communis*, pest and beneficial insects, species diversity, equitability indices.

Introduction

Variety and abundance of species (=richness) in different types of ecosystems and communities is one of major theme of ecology in last decades. Agrochemicals applications have important influence on the arthropods communities on agricultural. Increased use of agrochemicals has been shown to change species composition, decrease species diversity and course outbreaks of pest species in fruit orchard (Brown 1993, Margarit & all 1996, Brown & Schmitt 2001).

The aim of this study was to evaluate the richness, evenness and diversity values for the pest and beneficial insect communities in the pear orchard of Research and Development Institute for Plant Protection Bucharest-Baneasa under chemical conditions and to examine their seasonal changes. Pear trees, as agroecosystem, remarks by its perennial and monoculture, what led to form a specific entomofauna represented by the phytophagous species strict tied by food substratum (ex. psyllid species) and zoophagous species (parasites and predators) giving it a special characteristic.

Regarding this subject, it is important to get new information to increase the quantity and quality of knowledge about insect community associated with pear trees, to find out new management strategies with satisfactory effect against the pest and less dangerous to the community of the beneficial insects.

Materials and methods

In the experimental pear orchard of the RDIPP Bucharest-Baneasa area, a study on the insect community was carried out from April to September, 2003. The pear orchard, over 25 years old, was manage since the 80s by a standard chemical program with pirethroid sprays to control the main pests, pear psyllids, aphids and leaf weavils. There were one pre-bloom oil and three post-bloom pirethroid applications.

Tree canopies were sampled by bating tray every week, 100 branches were beat by a stik above a 50 cm diameter entomological funnel. The trees were randomly selected for each sampling date. Then, the collected insects were identified to species, genus and families using specific keys. Insect species were divided into two categories: the pest and beneficial (predators and parasites), which were analysed separatly. Parasitic Hymenopteras were identified to hiperfamily. This material does not include the data on the pest mites and aranea group, which were taken out from the samples. A specific Romanian pheromone trap (1trap/orchard) was applied for capturing the codling moth.

The diversity of pest and beneficial insect species was computed by Shannon-Wiener (Ceapoiu, 1968) and equitability indices (Lloyd & Ghelardi 1964).

Results and discussion

A part of data from this study were used in previously two papers, which described the structure and ecological parameters (abundance, frequency,

constancy and dominance) of insect community in pear orchard exposed to the usual chemical treatments used in pest control.

Insect taxonomic groups collected by beating tray in pear orchard at RDIPP Bucharest in 2003 are shown in tables 1 and 2. A total of 26031 specimens were collected, from which 22194 belonging to pest entomofauna and 3837 belonging to beneficial entomofauna.

Table 1

Relative abundance of pest insects (%)

Taxon	**April**	**May**	**June**	**July**	**Aug.**	**Sept**	**A-S**
	(%)						
Thysanoptera Thripidae	-		0,05	0,05	0,26	8,0	0,07
Heteroptera							
Tingidae *Stephanitis pyri* F., 1775	0,63	0,44	-	0,1	0,26	-	0,11
Cydnidae *Tritomegas bicolor* L., 1758	-	0,15	0,01	-	0,05	-	0,02
Pentatomidae	-	0,05	0,03	-	-	-	0,02
Homoptera							
Aphididae							
Aphis pomi De Geer, 1778	1,05	0,83	0,1	0,03	0,05	36,0	0,20
Dysaphis pyri Boyer., 1841	1,05	0,97	0,14	0,05	0,05	36,0	0,24
Coccidae *Quadraspidiotus perniciosus* Comst., 1880	-	0,2	0,06	-	-	4,0	0,05
Cicadellidae *Cicadella viridis* L., 1758	-	0,1	0,08	0,09	0,10	8,0	0,09
Psyllidae							
Cacopsylla pyri L., 1758	76,4	78,7	97,0	97,6	97,7	-	95,0
C. pyrisuga Först., 1848	5,27	2,6	0,35	-	-	-	0,51
C. melanoneura Först., 1848	0,84	0,54	-	-	-	-	0,07
C. bidens Šulc., 1907	-	1,61	1,38	1,6	0,3	-	1,35
Coleoptera							
Elateridae *Agriotes obscurus* L., 1758	-	0,15	0,04	0,03	0,10	-	0,05
Mordellidae *Mordelistena parvula* Gyll., 1827	-	0,1	0,04	-	-	-	0,02
Anthicidae							
Anthicus hispidus Rossi., 1792	0,21	0,24	0,02	0,01	-	-	0,04
A. antherinus L., 1761	0,42	0,1	0,03	-	-	-	0,03
Nitidulidae							
Meligethes aeneus F., 1775	-	0,2	0,02	-	0,10	-	0,03
M. maurus Sturm.,1845	-	-	0,04	0,01	0,05	-	0,02
Buprestidae *Agrilus viridis* L., 1758	-	0,05	0,04	0,01	0,05	4,0	0,03
Chrysomelidae							
Chaetocnema aridula Gyll., 1827	-	0,05	0,02	0,03	0,10	4,0	0,03
Longitarsus tabidus F., 1775	-	0,05	0,03	-	-	-	0,02
Phyllotreta nemorum L., 1758	-	-	0,04	0,05	0,05	-	0,04
Ph. vittula Red., 1849	-	-	0,02	0,01	0,10	-	0,02
Curculionidae							
Phyllobius oblongus F., 1758	7,17	7,04	0,05	0,01	-	-	0,83
Polidrusus inustus Germ., 1824	4,0	4,40	0,02	-	-	-	0,5

Taxon	April	May	June	July	Aug.	Sept	A-S
	(%)						
Sciaphobus squalidus Gyll., 1834	2,32	0,2	-	-	-	-	0,06
Scolidiidae *Scolytus rugulosus* Ratz., 1837	-	0,15	0,02	-	-	-	0,02
Lepidoptera Tortricidae *Cydia pomonella* L., 1758	-	-	0,26	0,26	0,68	-	0,3
Diptera							
Itonididae *Dasyneura pyri* Bauche., 1847	-	0,20	0,07	-	-	-	0,05
Chloropidae	0,63	0,34	0,03	0,01	-	-	0,06
Agromyzidae	-	0,44	-	-	-	-	0,04
Tripetidae	-	0,15	0,01	-	-	-	0,02
Total no. individuals	**474**	**2046**	**10135**	**7591**	**1923**	**25**	**22194**
No. of samples	**2**	**4**	**4**	**4**	**4**	**1**	**19**

Table 2

Relative abundance of beneficial insects (%)

Taxon	April	May	June	July	Aug.	Sept.	A-S
	(%)						
Thysanoptera Aeolothripidae *Aeolothrips.intermedius* Bagnall, 1934			0,17	0,29	0,53		0,26
Dermaptera Forficulidae *Forficula auricularia* L., 1758		0,75	1,58	2,0	1,69	0,63	1,56
Heteroptera							
Anthocoridae							
Anthocoris nemoralis F.,1794	-	3,78	10,3	12,9	10,1	3,77	9.8
Orius sp.	-	0,38	4,0	7,63	5,08	4,72	5,0
Antocoridae larvae	-	-	3,0	5,15	3,60	0,32	3,25
Miridae							
Campylomma verbasci M&D,1843	-	6,82	1,92	4,58	9,73	0,32	4,74
Deraeocoris lutescens Schill.,1836	-	-	1,0	1,05	3,07	-	1,35
D. ruber L.,1758	-	-	0,08	0,38	0,21	-	0,18
D. olivaceus L.,1777	-	-	0,08	0,1	0,10	-	0,08
Orthothylus sp.	-	-	0,08	0,1	0,10	-	0,08
Pilophorus perplexus Dougl&Scott, 1875	-	-	2,08	10,2	3,38	0,32	4,30
Miridae larvae	-	-	1,25	2,19	0,63	-	1,15
Nabidae							
Himacerus apterus L.,1798	-	-	-	0,19	0,32	-	0,13
Nabis ferus L.,1758	-	-	-	0,19	0,21	-	0,10
Neuroptera							
Chrysopidae							
Chrysoperla carnea Steph.,1836	6,56	1,89	0,67	2,76	2,22	5,66	2,21
Chrysopa sp.	-	-	0,08	0,19	0,10	-	0,10
Crisopidae larvae	-	-	-	0,38	1,69	0,63	0,57
Hemerobiidae *Hemerobius humulinus* L.,1758	1,64	0,38	0,42	0,29	0,95	0,32	0,52
Panorpidae *Panorpa communis* L.,1758		0,38	0,08		0,21		0,10

Taxon	April	May	June	July	Aug.	Sept.	A-S
	(%)						
Raphidioptera Raphidiae *Raphidia sp.*			0,08		0,10		0,05
Hymenoptera							
Sf. Chalcidoidea	6,6	2,65	4,59	3,53	13,1	4,40	6,28
Aphidiidae			0,42	0,29	0,63	-	0,36
Braconidae			0,08	0,38	0,42	-	0,23
Sf. Ichneumonoidea.		0,75	0,42	0,38	0,53	0,32	0,44
Sf. Formicoidea	70,5	64,4	60,3	36,5	33,9	64,1	48,0
Vespidae *Vespula germanica* F., 1793	-	-	0,25	1,9	2,43	4,40	1,56
Coleoptera							
Carabidae *Lebia humeralis* Dej., 1825	-	-	0,08	0,29	-	-	0,10
Cantharidae *Cantharis fusca* L., 1758	-	1,14	0,33		0,42	-	0,28
Staphylinidae	-	0,38	0,17	0,19	-	-	0,13
Lathridiidae	-	0,38	0,42	0,38	-	-	0,26
Corticarina gibbosa Hbst., 1793	-	-	0,17	0,19	-	-	0,10
C. elongate Gyll., 1834	-	0,38	0,25	0,19	-	-	0,15
Coccinellidae							
Adalia bipunctata L., 1758		6,06	1,33	1,05	0,53	3,77	1,56
Adonia variegate Goeze, 1777	-	-	0,17	0,1	0,21	0,32	0,13
Chilocorus bipustulatus L., 1758	-	-	0,08	0,29	0,32	0,63	0,23
Coccinella 7-punctata L., 1758	-	3,03	1,17	0,86	0,63	1,57	1,09
C. 10-punctata L., 1758	-	-	0,25	-	0,32	-	0,15
C.14-punctata L., 1758	1,64	0,38	0,08	0,1	0,21	0,32	0,18
Exochomus 4-pustulatus L., 1758	4,92	0,75	0,08	0,29	0,42	-	0,33
Halyzia sedecimguttata L., 1758	-	-	0,58	-	-	0,32	0,21
Hippodamia 13-punctata L., 1758	-	-	0,08	0,1	-	0,32	0,08
Propylaea 14-punctata L., 1758	-	1,14	-	-	-	1,58	0,21
Scymnus sp.	4,9	-	0,17	0,1	0,53	-	0,28
Stethorus punctillum Weise, 1891	-	-	-	0,19	0,21	-	0,10
Synharmonia conglobata L., 1758	-	-	0,17	0,19	-	1,26	0,21
Coccinelidae larvae	-	-	1,00	0,86	0,32	-	0,62
Diptera							
Sciaridae *Bradisia fungicola* Winn., 1867		2,27	0,25	0,29	0,21		0,36
Syrphidae	-	0,38	0,58	0,86	0,53	-	0,57
Epysirphus balteatus De Geer, 1776	-	-	0,50	0,48	0,21	-	0,33
Syrphidae larvae	-	0,38	0,08	0,38	0,32	-	0,23
Tachinidae	3,3	1,89	0,25	0,38	0,1	-	0,39
Total no. individuals	**61**	**264**	**1199**	**1049**	**946**	**318**	**3837**
No. of samples	**2**	**4**	**4**	**4**	**4**	**1**	**19**

The pest entomofauna was framed in 21 families and 32 species and the beneficial entomofauna was framed in 2 hyperfamilies, 21 families and 45 species. The dynamic of the numerical abundance of the two insect sub-communities, pests and beneficials, (table 1 and 2) was similar throughout the seasons, April-September, with the maximum of abundance recorded in June (10135 individuals for the pests and 1199 individuals for the beneficials) and July (7591 individuals for the pests and 1049 individuals for the beneficials).

The richness species (represented by species number) of pest and beneficial entomofauna recorded in pear ecosystem under the pesticides treatments

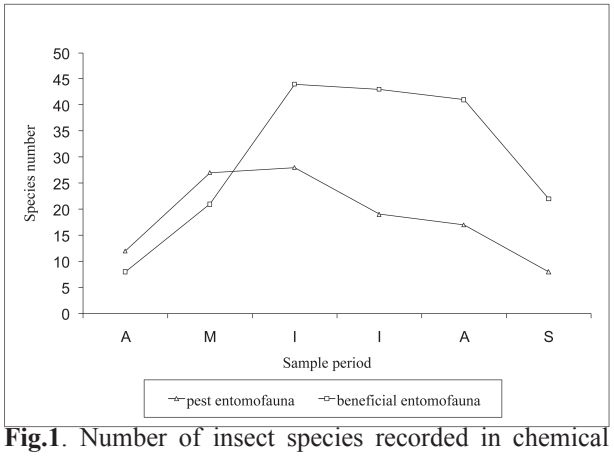

Fig.1. Number of insect species recorded in chemical sprayed pear orchard.

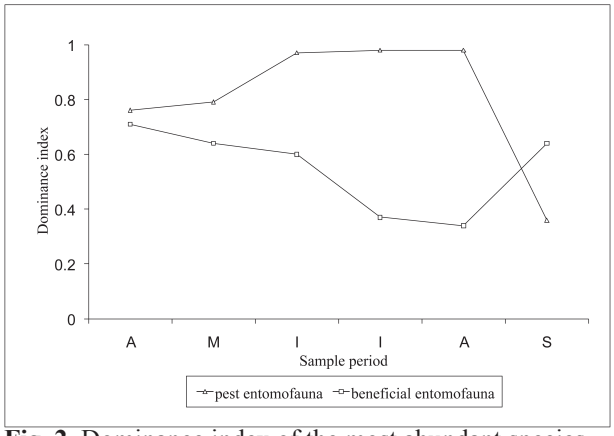

Fig. 2. Dominance index of the most abundant species.

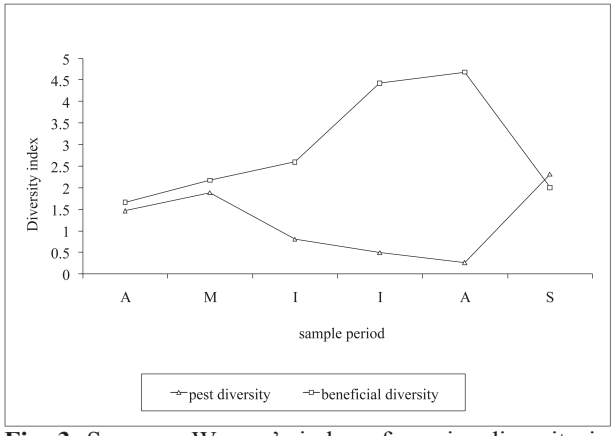

Fig. 3. Shannon-Wiener's index of species diversity in chemical sprayed pear orchard.

is shown in fig. 1. Excepting April month, the beneficial entomofauna was more species-rich than the pest entomofauna. For the two comunities, the lowest number of taxa was in April (8 species for beneficials and 12 species for pests) and September (8 species, respectively, 22). The maximal number was recorded in May (27 species) and June (28 species) for pests and in June (44 species), July (43 species) and August (43 species) for beneficials.

The dominance indices of the most abundant species of two insect communities are presented in figure 2. The pest entomofauna was dominated

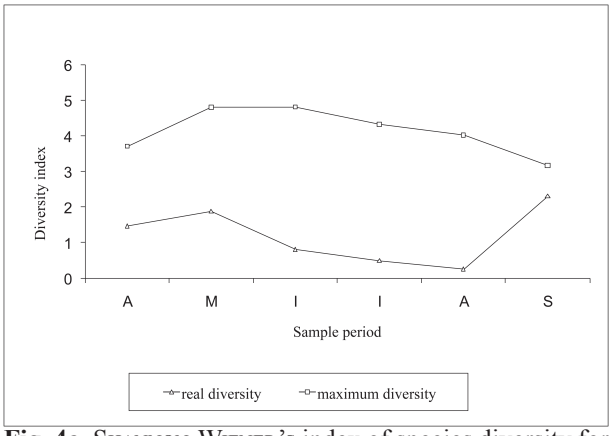

Fig. 4a. Shannon-Wiener's index of species diversity for the pest insect community in chemical sprayed pear orchard in comparison with theoretical community.

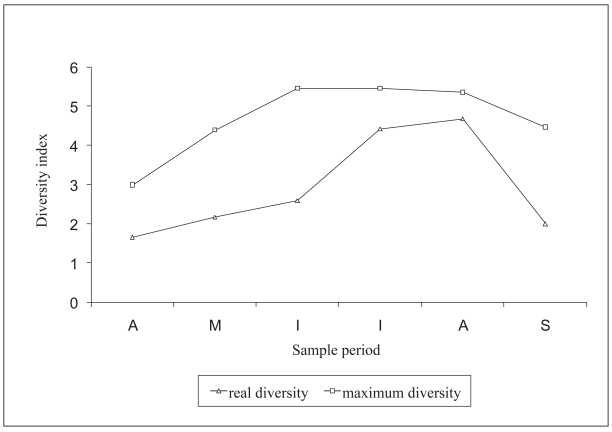

Fig. 4b. Shannon-Wiener's index of species diversity for the beneficial insect community in chemical sprayed pear orchard in comparison with theoretical community.

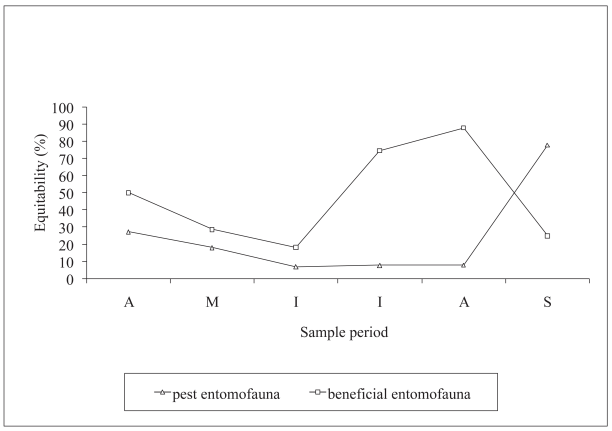

Fig. 5. Equitability index of insect community in chemical sprayed pear orchard.

numerically by the common psylla *C. pyri* in each sample, except September when this insect was not present in the single sample which was taken in this month. It was the result of the three pirethroid applications used just for its control. Dominance of *C. pyri* was very high in all samples, between 0.76-0.98. For a long time, this insect is among the most damaging arthropod pest of pear orchards, with uncontrollable populations. In September, two aphids species, *Aphis pomi* and *Dysaphis pyri*, be-

came dominant with a moderate dominance indice of 0.36.

For beneficial species, the dominant group was ants. Ants have a significant role in ecosystems because of their abundance, diversity and special behavioral attributes (Paulson & Akre 1992). They are found together with colonies of psyllids and aphids. The psyllids and aphids produce honeydew and the ants use the sugary liquid for food. They are found in all samples from April to September, with dominance indices from 0.34 to 0.71. The next most abundant species was *Anthocoris nemoralis*, the common predator associated with psyllid colonies, being particularly important in controlling pear psyllids (Civolani & Pasqualini 2003, Solomon et all. 2000). *A. nemoralis* is attracted by odours from psylla-infestations in pear trees (Drukker & Scutareanu 1993). It was found from May to September, its dominance was between 0.031-0.13.

Insect species diversity in RIPP pear ecosystem expressed by Shannon-Weaver indices are presented in fig. 3. There were differences in species diversity between the two communities. These are given by the differences in number of species what means species richness (fig. 1) and in dominance indices (fig.2) what measure evenness of species.

Beating tray sampling showed in fig. 3 that the diversity species of natural enemies was consistently greater over time than pests, excepting September month. The differences between the two communities were very pronounced from June to August, when the beneficial species number was more than 40 species, while the pest species number was between 17-28 species.

In the pest insects community, data pointed in fig 3 shows generally, very low values of the Shannon-Weaver index. Species diversity was different between all months, being higher in April (1.46) and May (1.88). In this period, species number was 12-27 and abundance of common pear psylla was relatively moderate 0.76-0.79. During summer months, the diversity indices showed a strong decrease in diversity of pest insects, 0.8 (June), 0.49 (July) and 0.26 (August). In this period, the number of species (fig.1) was 17-28 and the dominance indices (fig. 2) of *C. pyri* (dominant species) had the highest level from all samples (0.98). In September, without presence of common psylla in sample, the value of diversity indice was 2.31. A higher dominance index means a lower uniformity of species (Brown 1993). According to Brown, of these two elements, the uniformity of species abundances seems to be more important in the appearance of the difference in community diversity.

For the beneficial insect, the diversity indices showed an increase in diversity from April to August. The small values of diversity idices were reached in spring (1.66-2.17) and autumn (2). In this time, beneficial entomofauna was caracterised by a small number of species and high dominance indices of ants group (0.6-0.71). Food type represented by sweet excrements of pear psylla larvae can explaine the permanent presence of ants group with high numerical abundance.

Late summer, the richness of species with approximately equal distribution of individuals determined an increase of the diversity indices; they reached the highest values, 4.42 in July and 4.68 in August. In this time, there was a higher number of species, 43, respectively, 44, with moderate values of the dominant species 0.37 (July) and 0.34 (August). Also, the equitability indices tended to rise at 0.74 respectively, 0.84, what conffered a stable equilibrium for the beneficial entomofauna.

A comparison between the real diversity of species in pear orchard and the maximum diversity of a theoretic community is shown in fig. 4 (a, b). The pest community recorded the greatest differences between the values of real diversity and of maximum diversity than beneficial community.

Conclusions

There are differences in all the richness, evenness and diversity values for the pest and beneficial insect communities.

Data collected in the RDIPP pear orchard under the effect of insecticide treatments showed that the diversity of insect species, computed by Shannon-Weaver index, was corresponded with both the species number and the evenness of species abundance. A reduced species number and high dominant indices determinated a less in species diversity.

The overall period of samples, the pest entomofauna had fewer species (32 species) with a dominance index higher reached of pear psylla (0.76-0.98) (the most abundant species), while, the beneficial entomofauna had more species (48 species) and the dominance index lower reached of ants (0.34-0.71).

In the pest insect community, the species diversity, was higher in April (1.46) and May (1.88) and strong decreased in June (0.8), July (0.49) and August (0.26).The diversity of beneficial species was the greatest in July (4.42) and August (4.68) and the lowest from April to June (1.66-2.59). In September, the pest insect community (without presence of common psylla in sample) had a value

of diversity indice of 2.3, and the beneficial community had a value of diversity indice of 2.0.

Equitability indices values for beneficial populations increased to about 1 in July and August, while that of pest populations decreased at levels of 0.29 and 0.18.

Changes in diversity of insect species what caracterised the pear orchard of RIPP Băneasa were the result of frequent pirethroid applications used for psyllids control. The beneficial entomofauna, in contrast to greater species number and diversity values, the numerical abundance was lower comparatively with pest entomofauna, the rata being of 0.17.

A good ecological equilibrium in the insect community by to enhance of beneficials is possible by the convert of the pest control measures to create the conditions as favorable as possible for beneficials, and especially avoiding the chemicals that will harm them.

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