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A Parazitoid Biocoenoses and Their Role in the Conservation of Natural Balance

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Abstract: For more than four decades (1967-2008), we have studied, in our research, the role of parasitoid insects in limiting the populations of insects injurious to cabbage crops, as well as parasitoid complexes controlling some colonies of aphids **(***Brevicoryne Brassicae* L., *Urolencon cichorii* Koch, etc.**).** Studying the complexes of parasitoids that limit the populations of some pest insects, we have realized that these form biocoenoses of special type, depending on their existence on each other and the whole they form. These structures were named **biocoenoses of parasitoid type,** starting from the ideas of **P. Jourdheuil** (1960), who launched the concept of **parasitic biocoenosis**. We consider that the **parasitoid biocoenosis** is more correct because the insects act as **parasitoids** not as **parasites** because they kill their hosts. We present different types of parasitoid biocoenoses, the structure and their functional characteristics, as well as their role in preserving the natural equilibrium, beyond any anthropogenic impact.

Keywords: pests, parasitoids, hyperparasitoids, entomophages, parasitoid biocoenoses, entomophagous biocoenosis, natural equilibrium.

Introduction

Our researches were accomplished in Moldova and Constanța County, in the conditions offered by the Romanian Black Sea seaside.

There were accomplished the complexes of entomophages (predators and parasitoids) that control the insect populations injurious to cabbage crops, as well as the complexes of parasitoids that act in the colonies of some aphids, limiting their populations [1,5,6,12,14,15,31].

The understanding of the concept of parasitoid biocoenosis is not so simple as it may seem. It is part of a more complex biocoenosis that operates independently. It is not just about a number of species that are associated and depend on each other, in their existence, regardless of time and space, but much more [6,12,24,26].

If a vegetable garden represents an **original ecosystem,** then its biocoenosis is an **agrobiocoenosis**. The vegetable garden presents as **producers** different vegetable species: cabbage, tomatoes, cucumbers, onion, potatoes, etc. Each of these species of producers attracts through its presence in the vegetable garden a number of **phytophagous consumers** according to their preference for their food. Some phytophagous species can attack two or even more species of producers, but we can individualize the complex of natural enemies for each species of producers.

By their presence on the host plants, the phytophages (primary consumers) attract a number of predators and parasitoids that control their existence. Gardeners and parasitoids form what we call the **entomophagous fauna** [28,29].

Regarding parasitoids, we have to mention that these are of different degrees: **primary, secondary, tertiary** and even **quaternary**. These, like predators, represent zoophagous consumers, which can be, as we have pointed out, of different degrees up to the top consumers.

We find that each primary consumer (phytophage) is controlled by a series of predators and parasitoids that depend on their existence some of the others and the whole they form - **the biocoenotic complex** [15,18,22].

We can nominate a series of trophic chains of predatory or parasitoid type that act in such complexes.

I. Producer → phytophagous consumer (primary) → predator I (zoophagous consumer) → predator II → predator III; **(*Brassica oleracea* → *Brevicoryne brassicae* → *Syrphus corollae* → *Adalia bipunctata*)**;

II. Producer → phytophagous consumer (primary) → parasitoid **I** → parasitoid **II** → parasitoid **III** → parasitoid **IV**; **(*Brassica oleracea* → *Brevicoryne brassicae* → *Diaeretiella rapae* → *Charips arcuatus* → *Asaphes vulgaris* → *Pachyneuron aphidis*)**.

We can illustrate these trophic relationships in the form of some trophic pyramids:

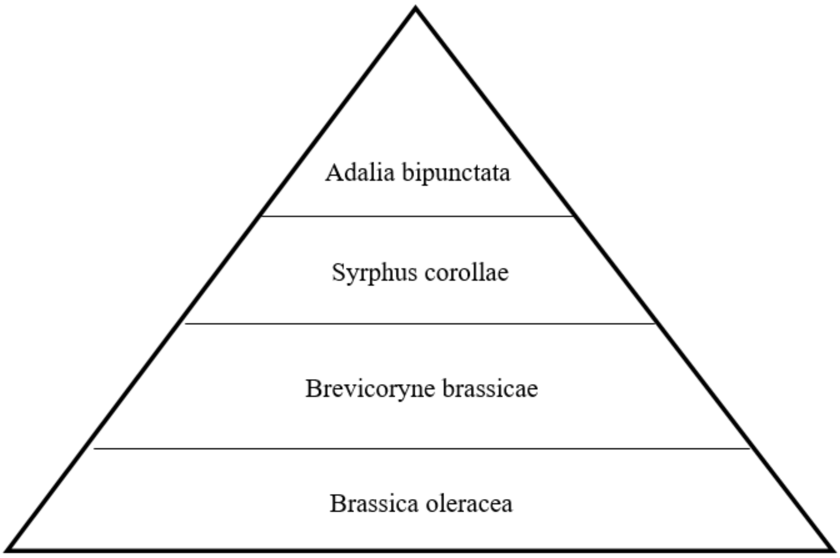


Fig. 1. The trophic pyramid of predatory type from the colonies of *Brevicoryne brassicae*

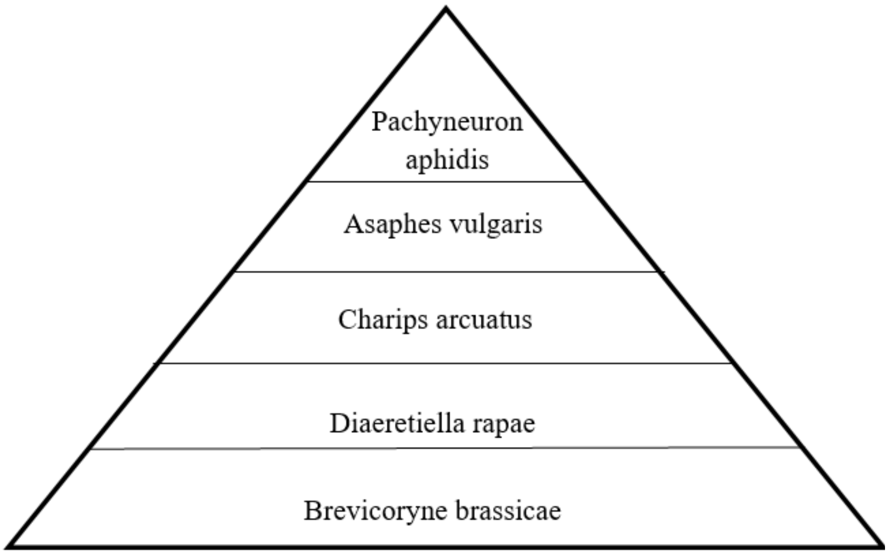


Fig. 2. The trophic pyramid of parasitoid type from the colonies of *Brevicoryne brassicae*

These were identified and individualized to better understand the interrelationships among the species of a biocoenotic system of entomophagous system. As a result, we shall discuss about different types of parasitoid biocoenoses to better intuit the structure and their functionality and their role in maintaining the natural equilibrium.

Biocoenosis, as a structural and functional whole, presents a special dynamics in time and in space and a characteristic evolution.

If the plants, as producers, depend on the place in which they appeared or were planted, the animals, as phytophages, predators or parasitoids, have a distinct dynamics that can easily pass from one area to another, or can migrate on very big distances.

Thus, the females of the parasitoid species are, during the reproduction period, in a perpetual search of the hosts for the future progeny. When the preferred host offers them a larger biomass of eggs, larvae or pupae, the females will deposit as many eggs as possible in the respective crop. If the hosts are more rare and distributed on a larger area, then the females would look for them with insistence in order to deposit their egg mass. In this way, we can explain why some species are eudominant or dominant in certain crops and semi-dominant or recessive in others [11, 16,17,18].

Complex relationships between plants and animals formed during the geological time.

Following the evolution of the world we find that insects had a parallel evolution with the higher plants with flowers. There is no species of flowering plants that do not become the target of the attack of some phytophagous insects. They attract, by their presence on the host plants, a series of entomophagous insects (predatory and parasitoids) that control their populations. As regards the species of parasitoid insects, these can act as primary, secondary, tertiary and quaternary parasitoids.

In a biocoenotic system of parasitoid type, relationships of cybernetic type are established ensuring the formation of some self-adjustment mechanisms which do not allow the exponential development of some species in conformity with the model in Fig. 3.

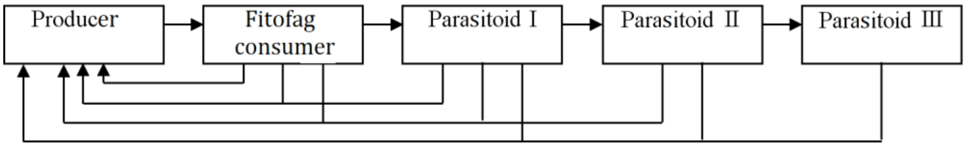


Fig. 3. Self-adjustment mechanisms in a biocoenotic system of parasitoid type

We have to understand that these complexes of parasitoids that control the populations of some species injurious to plants do not represent a sum of species associated by chance, on the contrary they form biocoenotic complexes of particular type -parasitoid biocoenoses, in which the species in their existence depend on each other and on the functional whole they make it together. We bring evidence by which we demonstrate the role of these biocoenoses in the keeping of natural balance, as long as some anthropic perturbation factors do not act to cause a certain imbalance between species affecting the integrality of the biocoenotic complex.

*

We further present a series of trophic networks of some insects injurious to cabbage crops to better understand the structure of biocoenoses of parasitoid type: ***Autographa gamma*** **L.** (Fig. 4), ***Mamestra brassicae*** **L**. (Fig. 5), ***Pieris*** (Fig. 6) [13,28].

Further on, we will present and discuss, especially from a didactic point of view, some trophic networks characteristic to the parasitoid complexes that act in the populations of ***Plutella xylostella***, representing true parasitoid biocoenoses.

By comparing such trophic networks, we can truly understand what the biocoenotic complexes of parasitoid type mean.

Plutella xylostella is a cosmopolitan species which is found on all the meridians of the world where cabbage is cultivated. This species has the ability to migrate over very big distances.

In Romania, it presents usually 3 generations in the south and 2 in the north; in certain years, it can have 4 or 5 generations in the south, and 3-4 in the north, depending on temperature; in tropical areas, it has up to 20 generations per year [8, 9].

In the conditions of our country, ***Plutella xylostella*** is controlled by an impressive complex of parasitoids that keeps it below the economic threshold of harm.

Resuming the analysis, we find that in Moldova, or even throughout Romania, the species ***Plutella xylostella*** that we have to discuss about, but also the species of ***Pieris*** are naturally controlled by the parasitoid complexes they interrelate with. Our researches come to confirm the reality of the concept concerning the existence of the world genetic centers for all the species that are in the biosphere [2,3,4,22].

In the same way, our researches demonstrate that, in fact, in nature, everything depends on everything. In Figure 7 we present a trophic network obtained in the conditions of Moldavia in the 1967-1972 period.

In the researches carried out during this period, we collected 8,246 mature larvae and chrysalises of ***Plutella xylostella*** from 37 Moldavian localities. Of these, 7,239 of the hatched adults belonged to the pest and to the complex of parasitoids. A number of 1,212 individuals belonged to the host, representing 14.7%, the others belonging to a number of 26 primary parasitoid species and 4 species of secondary parasitoids (**Chalcididae**).

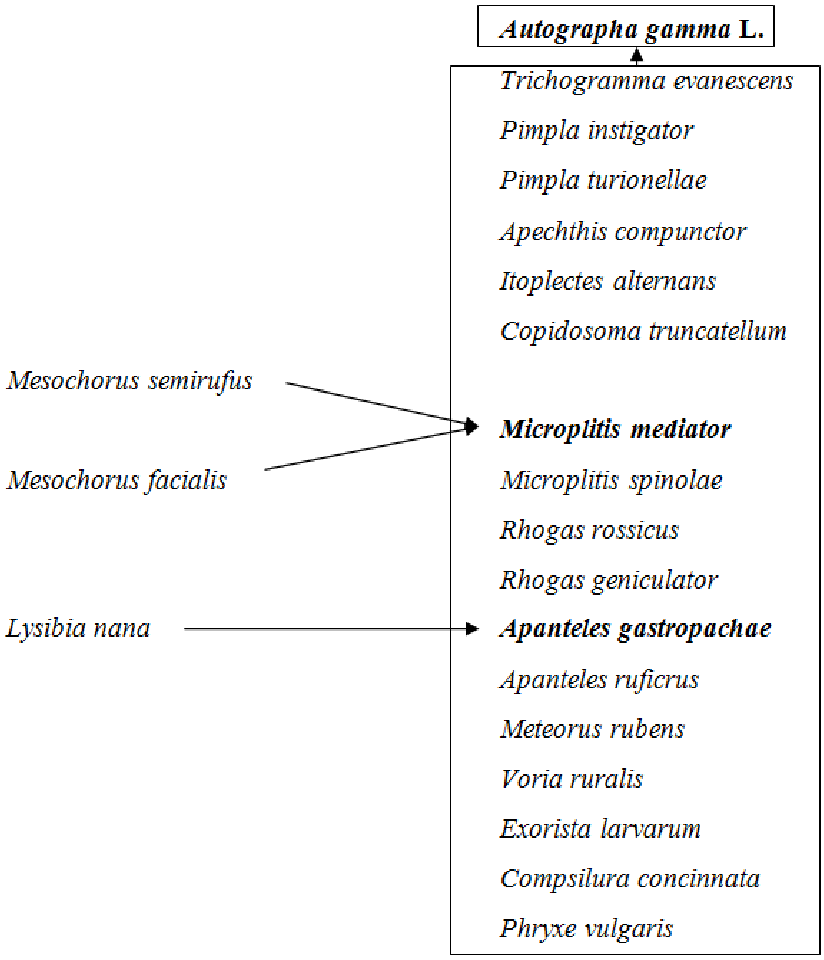


Fig. 4. The parasitoid complex limiting the *Autographa gamma* L. populations

We would like to point out that the 26 species of primary parasitoids succeeded to parasite some populations of ***Plutella xylostella*** in the proportion of 70-80%, or even 90%. The lowest value was recorded at Valea Lupului, Iași on August 27, 1971, of 29.40%, and the highest value in a cabbage crop from Vlăsinești, Botoșani, on August 4, 1970, 100% [16].

The data being published, the paper was found and consulted by some Taiwanese specialists from the **Asian Vegetable Research and Development Center (AVRDC)**, who were impressed by both the large number of parasitoids and their effectiveness.

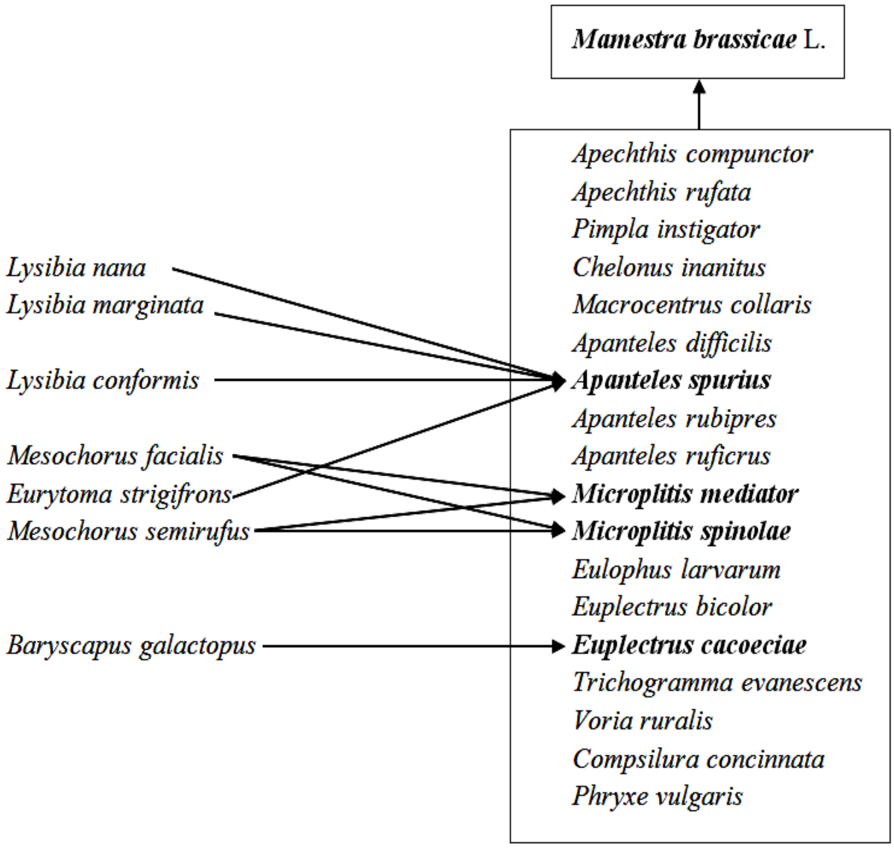


Fig. 5. The parasitoid complex limiting the *Mamestra brassicae* L. populations

They invited me to a congress held in Taiwan in 1990 and they wrote to me that, in the cabbage crops from there, only one parasitoid, ***Cotesia plutellae***, acts and it does not limit neither 1% of the populations of ***Plutella xylostella.***

In Figure 8 we present another trophic network obtained also in the conditions of 1967-1972 years from other localities in Moldova [17].

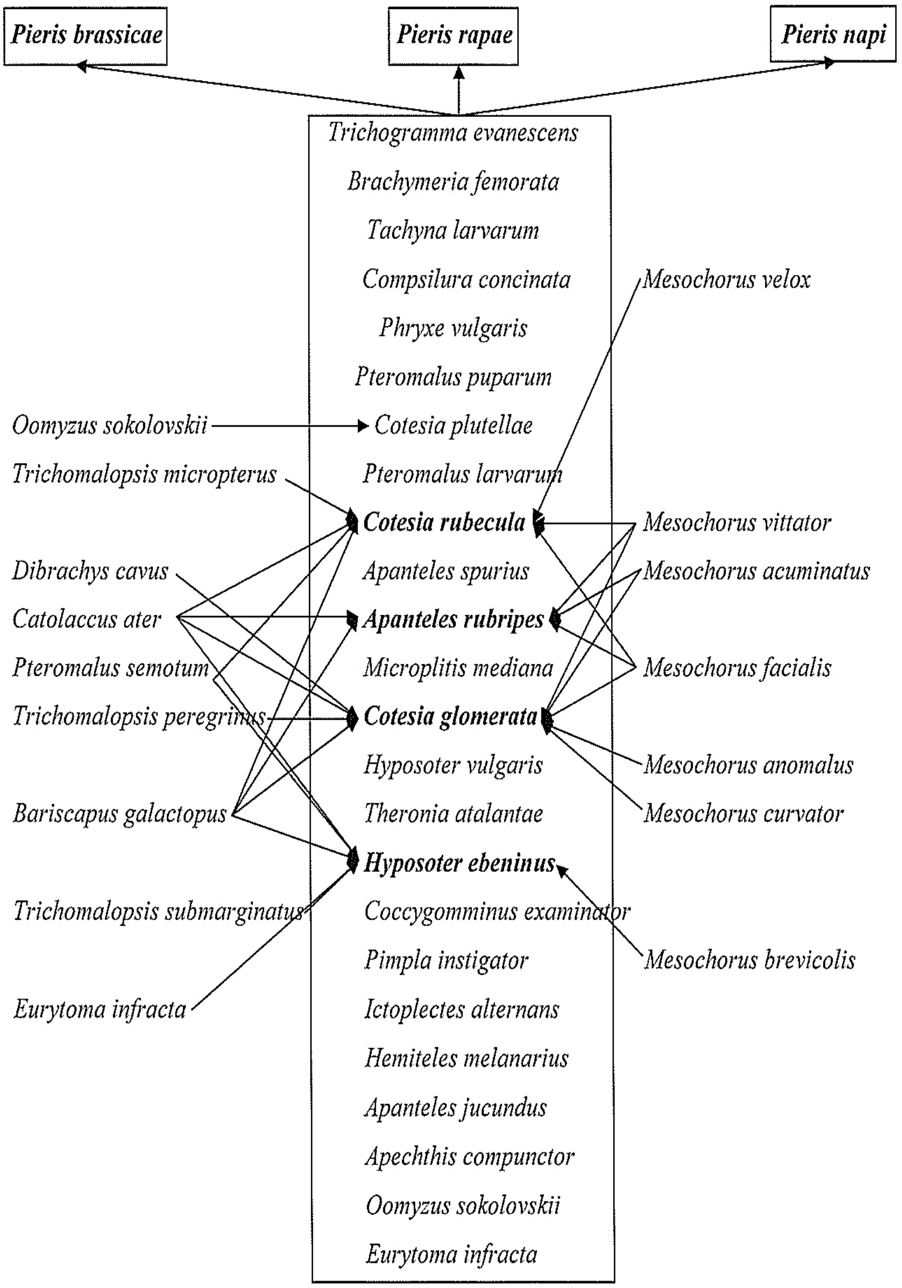


Fig. 6. The parasitoid complex limiting the *Pieris* populations

Those 28 species of primary parasitoids managed to limit the populations of ***Plutella xylostella,*** in percentages of 80-90 % in several cabbage crops.

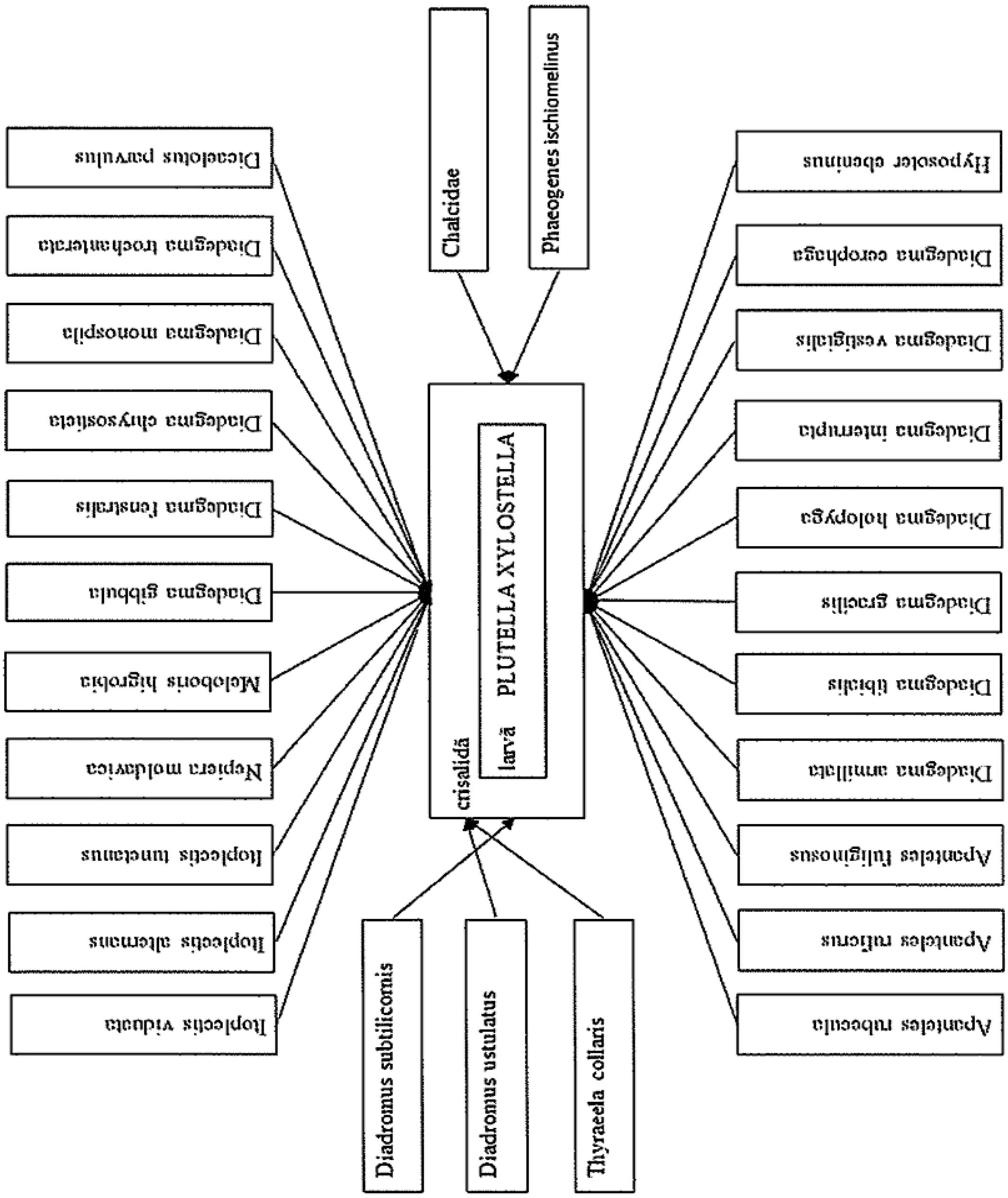


Fig. 7. The parasitoid complex limiting the *Plutella xylostella* L. populations

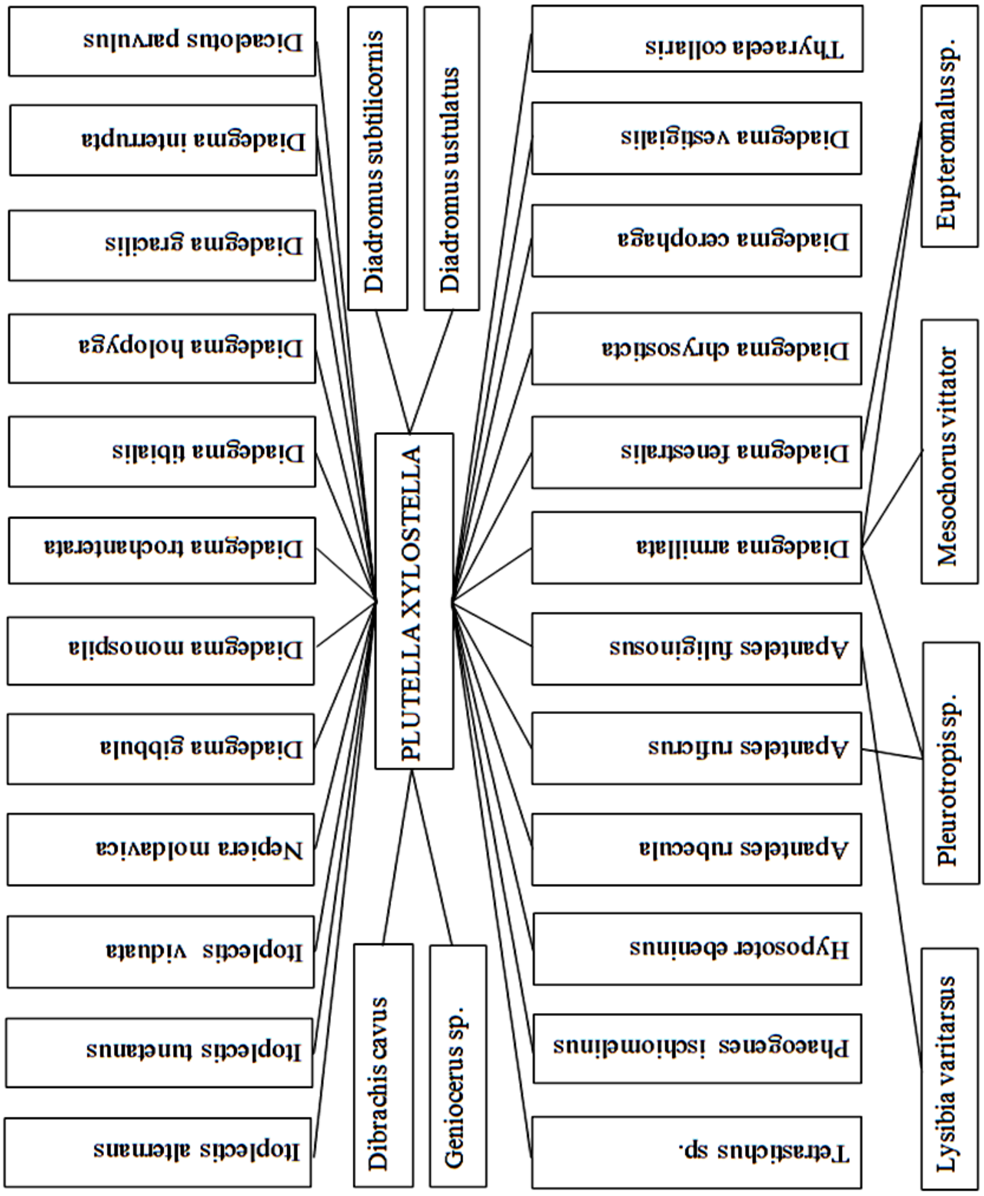
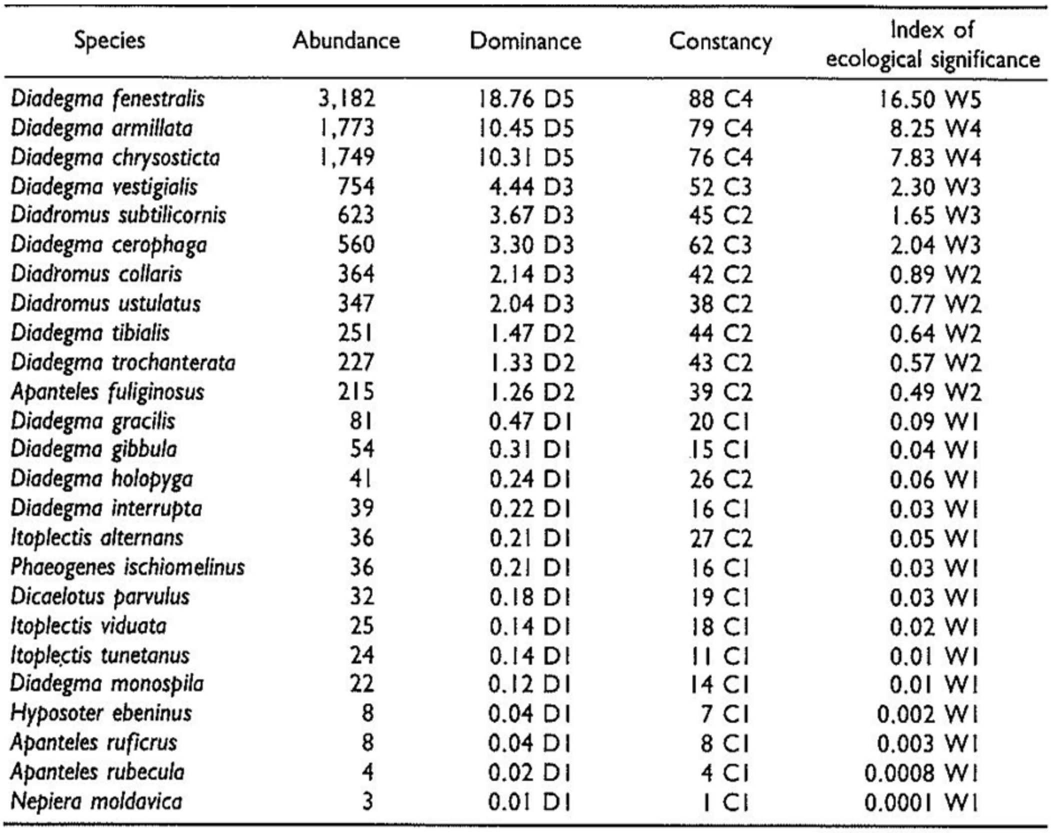


Fig. 8. The parasitoid complex limiting the *Plutella xylostella* L. populations

In order to understand the role of each species in limiting the host populations, we present, in Table I, the synecological analysis of the species in this biocoenotic complex. As we can find out, most species have an accidental presence in this biocoenotic complex, 3 species are euconstant, 2 species constant; 3 species eudominant, 5 semidominant and most subrecedent, which means that a few species had an essential contribution to the limitation of the populations of ***Plutella xylostella*** [17].

The accidental species have a lower contribution because, in this period, they preferred other species of phytophages, but they represent a sort of **"reserve army**" for the biocoenotic complex that may become important in other conditions [22].

Table 1. The synecological analysis of the parazitoid species in the populations of DBM



Species	Abundance	Dominance	Constancy	Index of ecological significance
Diadegma fenestralis	3,182	18.76 D5	88 C4	16.50 W5
Diadegma armillata	1,773	10.45 D5	79 C4	8.25 W4
Diadegma chrysosticta	1,749	10.31 D5	76 C4	7.83 W4
Diadegma vestigialis	754	4.44 D3	52 C3	2.30 W3
Diadromus subtilicornis	623	3.67 D3	45 C2	1.65 W3
Diadegma cerophaga	560	3.30 D3	62 C3	2.04 W3
Diadromus collaris	364	2.14 D3	42 C2	0.89 W2
Diadromus ustulatus	347	2.04 D3	38 C2	0.77 W2
Diadegma tibialis	251	1.47 D2	44 C2	0.64 W2
Diadegma trochanterata	227	1.33 D2	43 C2	0.57 W2
Apanteles fuliginosus	215	1.26 D2	39 C2	0.49 W2
Diadegma gracilis	81	0.47 D1	20 C1	0.09 W1
Diadegma gibbula	54	0.31 D1	15 C1	0.04 W1
Diadegma holopyga	41	0.24 D1	26 C2	0.06 W1
Diadegma interrupta	39	0.22 D1	16 C1	0.03 W1
Itoplectis alternans	36	0.21 D1	27 C2	0.05 W1
Phaeogenes ischiomelinus	36	0.21 D1	16 C1	0.03 W1
Dicaelotus parvulus	32	0.18 D1	19 C1	0.03 W1
Itoplectis viduata	25	0.14 D1	18 C1	0.02 W1
Itoplectis tunetanus	24	0.14 D1	11 C1	0.01 W1
Diadegma monospila	22	0.12 D1	14 C1	0.01 W1
Hyposoter ebeninus	8	0.04 D1	7 C1	0.002 W1
Apanteles ruficrus	8	0.04 D1	8 C1	0.003 W1
Apanteles rubecula	4	0.02 D1	4 C1	0.0008 W1
Nepiera moldavica	3	0.01 D1	1 C1	0.0001 W1

In the conditions of the 2001 year (fig. 9), we find that in the cabbage crops on the Black Sea coast, the trophic network was more or less similar to the others, even if some species of the primary parasitoids were replaced by others, but we find a much larger number of secondary parasitoids (ten species).

In the conditions of the year 2006 (fig. 10), the structure of the trophic network was much different, as there appeared many new species of primary parasitoids. The arrangement of the species in the trophic network does not present significance (being another type of model that respects the relations among species). The number of primary parasitoids was much lower (only 17 species), of which 8 species were new. Even if the number of secondary parasitoids was the same (10 species), five species were new. We reinforce on this occasion the significance of accidental or recedent and subrecedent species. They can become, in certain conditions, species of major significance within the biocoenotic complex. The new species of primary and secondary parasitoids come from this "**reserve army**" which we mentioned before.

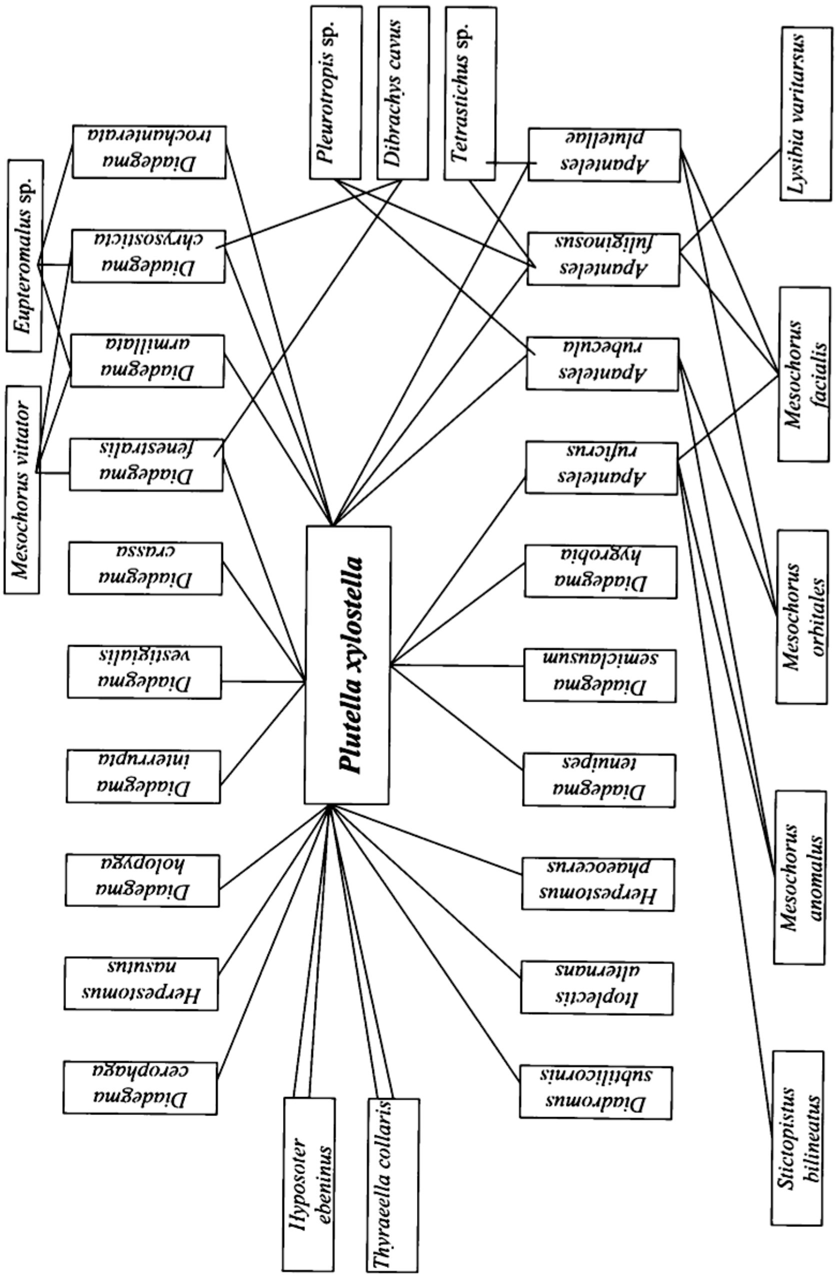


Fig. 9. The parasitoid complex limiting the *Plutella xylostella* L. populations

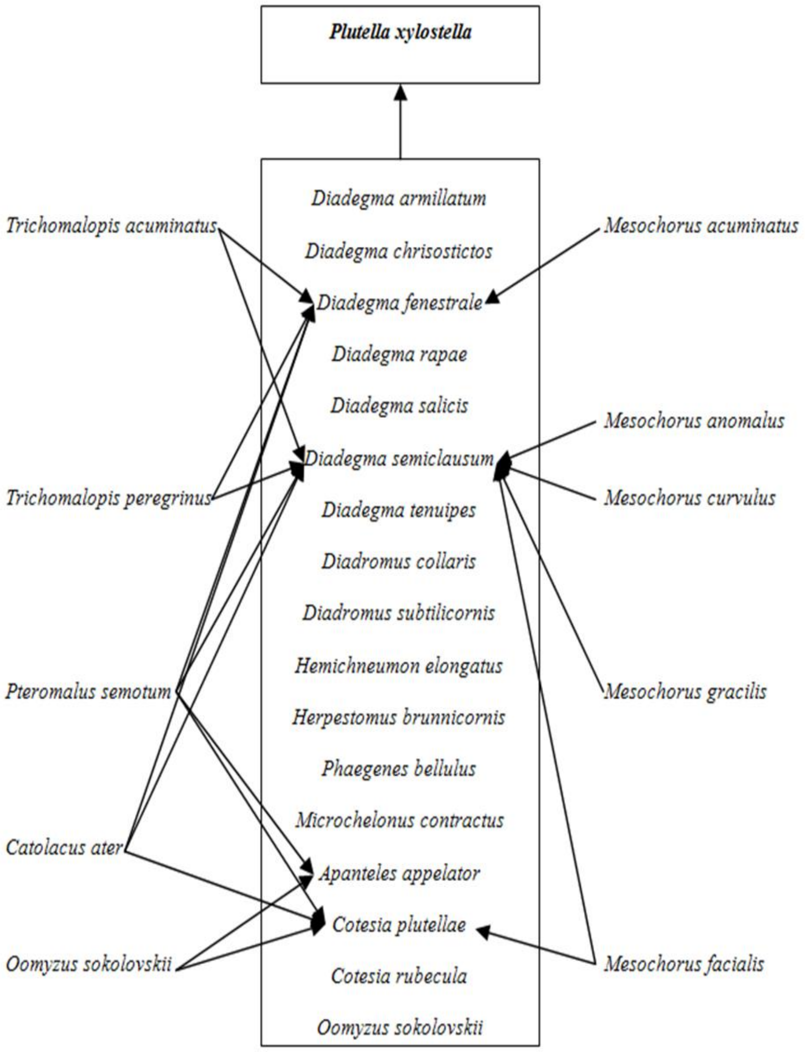


Fig. 10. The parasitoid complex limiting the *Plutella xylostella* L. populations

What is particularly important in this biocoenotic complex is the presence of the species ***Oomyzus sokolovskii***, which has a particular behaviour: it acts both as a primary parasitoid and as a secondary parasitoid, depending on the host larvae at its disposal. If a larva of ***Plutella xylostella*** is not parasited, the female of ***O. sokolovskii*** does not abandon it, but deposits an egg, acting as a primary parasitoid; if it encounters the larva of a primary parasitoid, then it prefers this, becoming a secondary parasitoid. In this trophic network, ***O. sokolovskii*** acts as a primary parasitoid in the larvae of ***Plutella xylostella*** and as a secondary parasitoid in those of ***Apanteles appellator*** and ***Cotesia plutella*** [20, 25].

The species with multiple ecological valences form the so-called buffer system of the biocoenotic complex, with special functions in maintaining the natural equilibrium. The buffer system does not allow the exponential multiplication of a species. If some species of primary parasitoids thrive in the host populations and offer numerous larvae, the species in the buffer system prefer them by reducing their populations.

In the colonies of aphids, there acts primary, secondary, tertiary and even quaternary parasites; in fact, the tertiary parasitoids can also act as secondary or quaternary parasitoids forming a buffer system. Thus, in the biocoenotic complex acting in the ***Brevicoryne brassicae*** colonies, which attack the plants of ***Brassica oleracea*** var. ***capitata*** L., the species of ***Asaphes*** and ***Pachyneuron*** form a very characteristic buffer system (fig. 11). ***Asaphes*** and ***Pachyneuron*** form buffer systems in other aphid colonies, as we can find in the case of the species ***Uroleucon cichorii*** Koch that attacks the endive plants (***Cichorium intybus*** L. Ssp. ***sativum*** (DC) Janchen, var. ***foliosum*** Heg. (fig. 12). The species ***Oomyzus sokolovski****i* and ***Eurytoma infracta*** form a buffer system in the populations of ***Pieris***, which attack the cabbage (fig. 4) [14,18, 27, 28].

The coming out of the buffer system signals us the installation of the maturity stage (**climax**) of the biocoenotic complex.

Through the buffer system, the biocoenotic complex provides itself a cybernetic mechanism through which it protects its existence and the functionality.

In fig. 13, we present a trophic network obtained in the conditions of the year 2007, in Moldova. First, we remain impressed by the large number of primary (32 species) and secondary (19 species) parasitoids. All of these parasitoids are found in nature; no species has been raised in the laboratory and launched in nature for the purpose of biological control of some pests.

In the conditions of Moldavia, ***Plutella xylostella*** is strongly restricted by the primary parasitoids complex, like the species of ***Pieris***. In Taiwan and Southeast Asia, where ***Plutella xylostella*** has up to 20 generations per year, multiplying itself like aphids, it becomes an extremely dangerous pest of the cabbage crops. It behaves like the ***Leptinotarsa decemlineata*** species in Europe, because it reached this area through migration, or by other means, without being accompanied by the complex of natural enemies [10,13, 32, 33].

Starting from the very large complexes of parasitoids controlling the populations of ***Plutella xylostella*** and of ***Pieris*** in the conditions of Romania, we have come „to the conclusion that these species have their **world genetic center** (according to the thought of the reputed geneticist **Nikolai Vavilov**) in this area of Europe, that is, in the center of Europe. We have to specify that Romania is in the center of Europe; its location in Eastern Europe is of a political nature [27, 28].

Living in the same area and depending on each other existence, the species have formed biocoenotic complexes in which the self-regulation mechanisms do not allow the exponential multiplication of a species to the detriment of others. Nature is intelligently structured, the biosphere functioning as a whole, **in which everything depends on everything** [19, 21, 23].

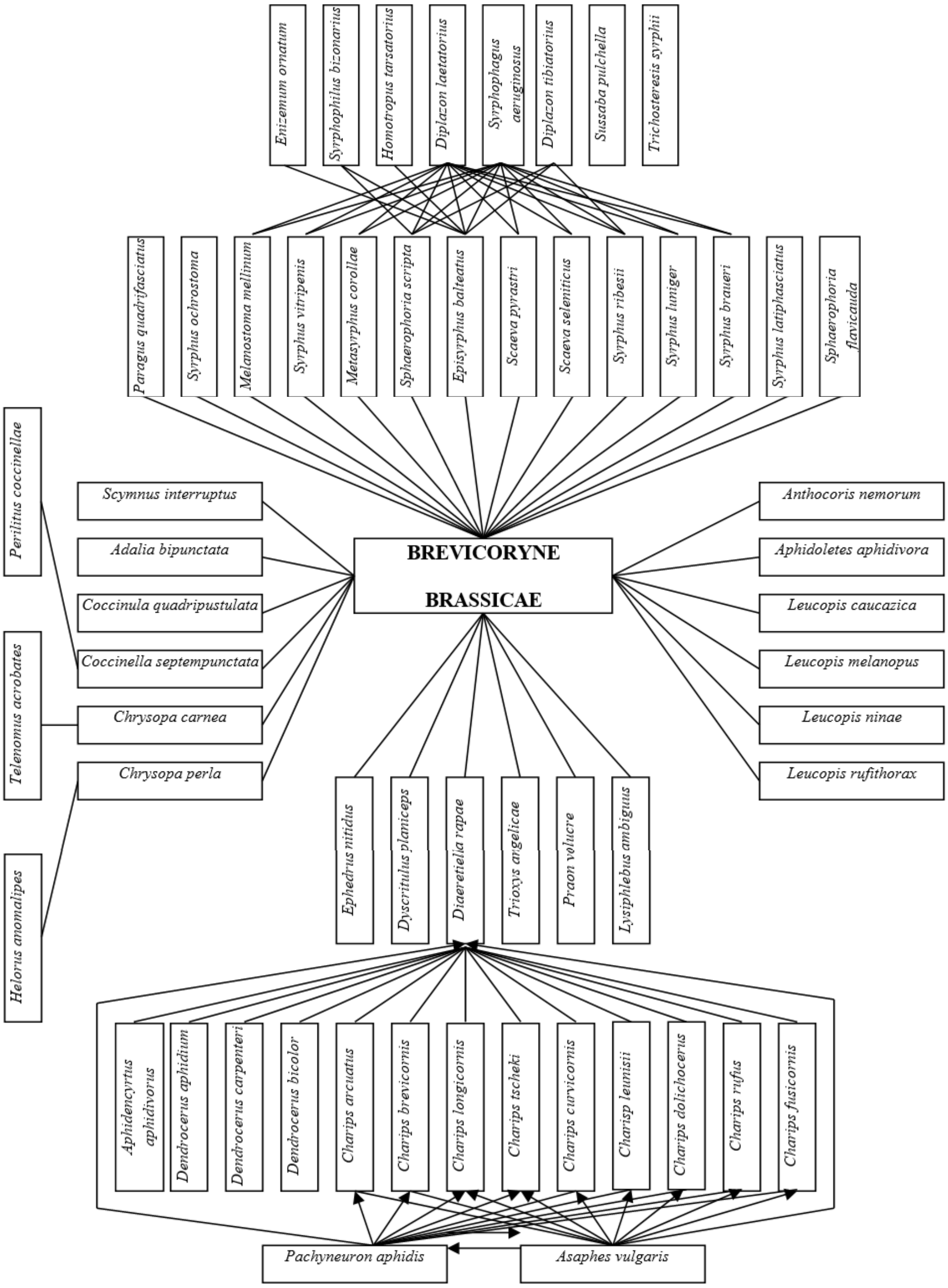


Fig. 11. The entomophagous complex limiting the *Brevicoryne brassicae* populations

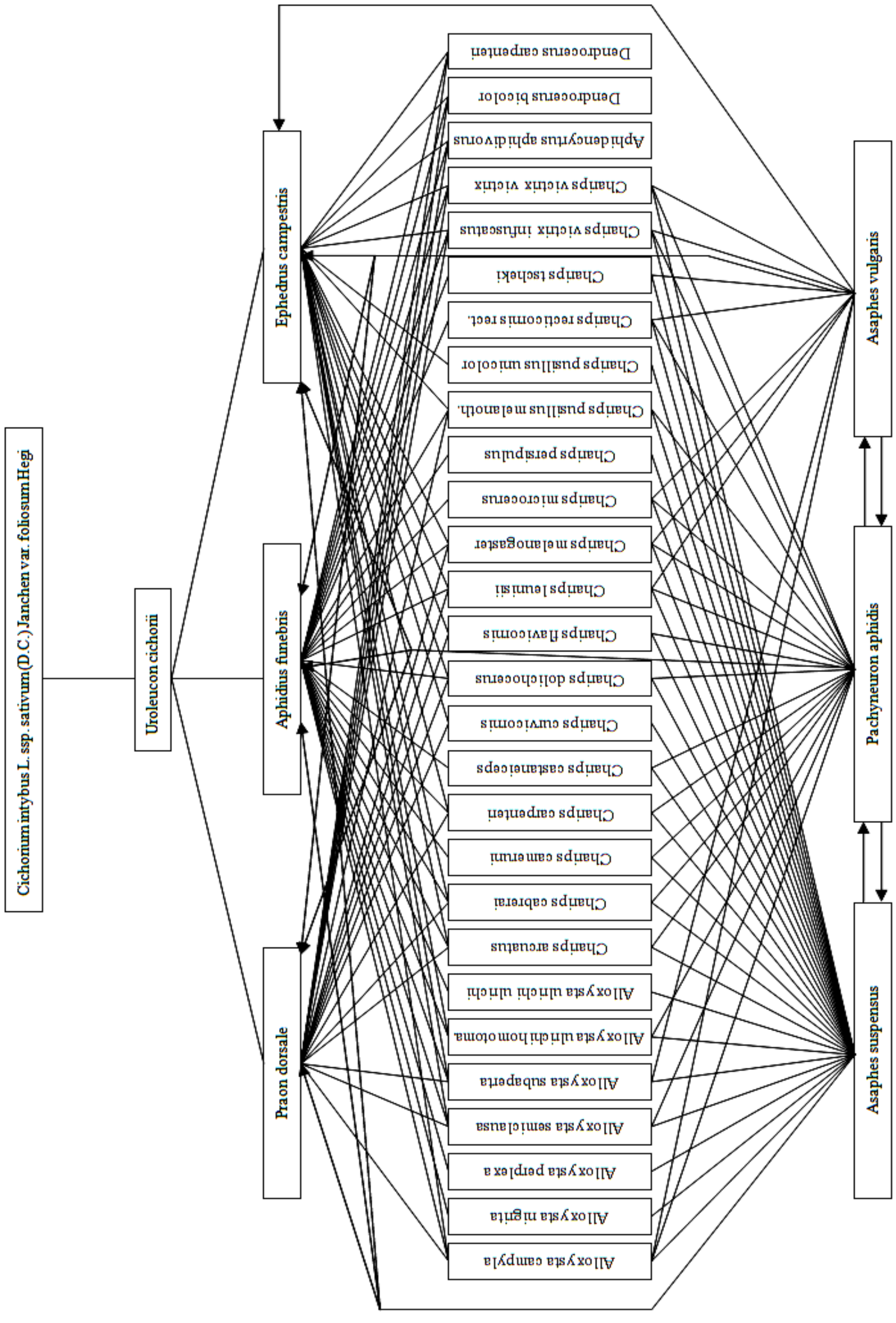


Fig.12. The parasitoid complex limiting the *Uroleucon cichorii* Koch populations

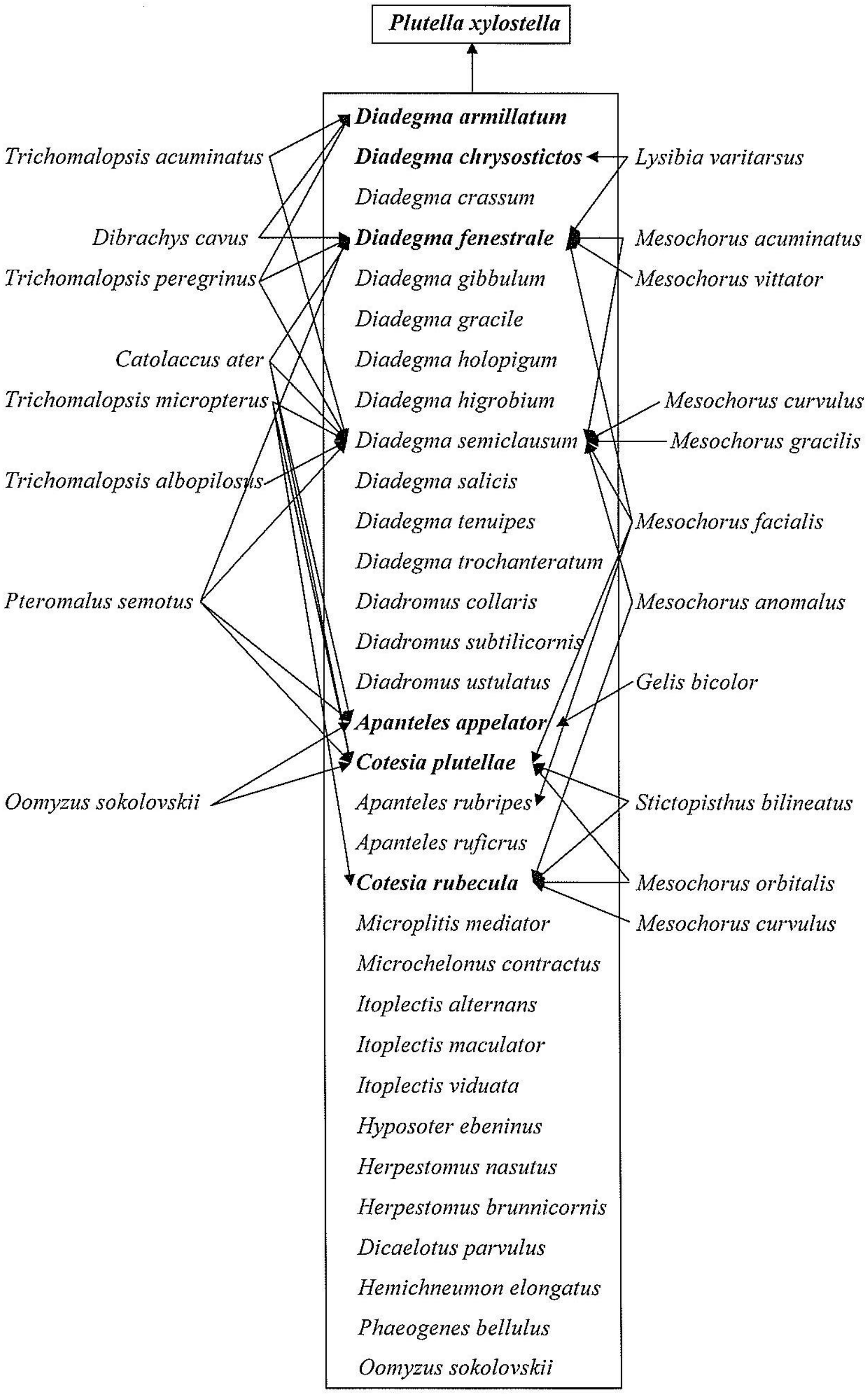


Fig. 13. The complex of parasitoids which limits the populations of *Plutella xylostella*

In the conditions of Romania and especially in Moldavia, the species ***Plutella xylostella*** is maintained by the parasitoids complex below the threshold of economic damage.

By performing a sinecological analysis of the parasitoid species that act in certain populations of ***Plutella***, we can find the role of each species in the limitation of host populations.

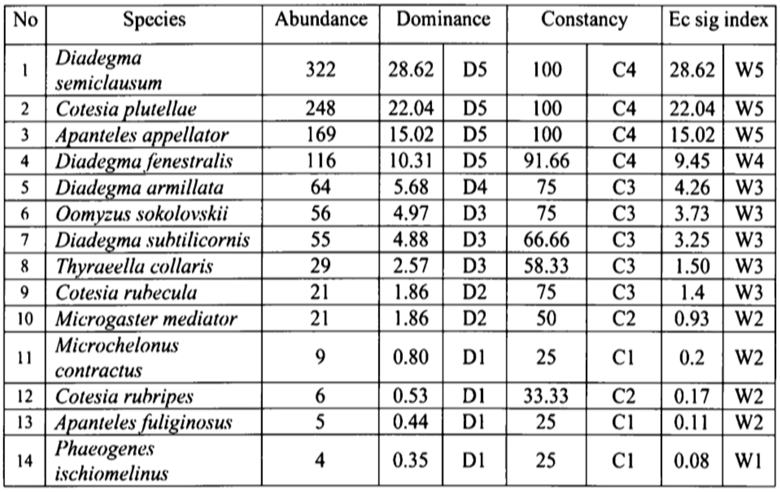
In Table 2 we present the sinecological analysis of the species of primary parasitoids. We find that the species ***Diadegma semiclausum, Cotesia plutellae, Apanteles appellator*** and ***Diadegma armillata*** act as eudominant and euconstant species and with a high ecological significance index (W5); ***Oomyzus sokolovskii, Diadegma subtilicornis*** and ***Thyraeella collaris*** act as dominant and constant species, having a major importance in the limitation of the populations of ***Plutella***. The rest of the species have a somewhat minor role in this process.

In Table 3, we present the sinecological analysis of the secondary parasitoids that have acted in the same cabbage crops. As we can control, the species ***Pteromalus semotus*** and ***Catolaccus ater*** act as eudominant and euconstant species.

Oomyzus sokolovskii, which we have encountered, also in the category of the primary parasitoids, manifests itself as a dominant and constant species with a high significance index (W4). This species is part of the buffer system of the biocoenotic complex. There follow 5 subdominant species, the others being recedent and subrecedent species.

What we have to mention from this sinecological analysis is the fact that the species of secondary parasitoids did not have only a formal presence within this biocoenotic complex, but they limited the populations of some primary parasitoids not allowing the exponential multiplication of some species. The good functioning of the biocoenotic complex is given by the presence of the buffer system ensured by ***Oomyzus sokolovskii.***

Table 2. The synecological analysis of the primary parazitoid species



No	Species	Abundance	Dominance		Constancy		Ec sig index	
1	*Diadegma semiclausum*	322	28.62	D5	100	C4	28.62	W5
2	*Cotesia plutellae*	248	22.04	D5	100	C4	22.04	W5
3	*Apanteles appellator*	169	15.02	D5	100	C4	15.02	W5
4	*Diadegma fenestralis*	116	10.31	D5	91.66	C4	9.45	W4
5	*Diadegma armillata*	64	5.68	D4	75	C3	4.26	W3
6	*Oomyzus sokolovskii*	56	4.97	D3	75	C3	3.73	W3
7	*Diadegma subtilicornis*	55	4.88	D3	66.66	C3	3.25	W3
8	*Thyraeella collaris*	29	2.57	D3	58.33	C3	1.50	W3
9	*Cotesia rubecula*	21	1.86	D2	75	C3	1.4	W3
10	*Microgaster mediator*	21	1.86	D2	50	C2	0.93	W2
11	*Microchelonus contractus*	9	0.80	D1	25	C1	0.2	W2
12	*Cotesia rubripes*	6	0.53	D1	33.33	C2	0.17	W2
13	*Apanteles fuliginosus*	5	0.44	D1	25	C1	0.11	W2
14	*Phaeogenes ischiomelinus*	4	0.35	D1	25	C1	0.08	W1

Table 3. The synecological analysis of the secondary parazitoid species

No	Species	Abundance	Dominance		Constancy		Ec sig index	
1	*Pteromalus semotus*	162	47.67	D5	100	C4	47.64	W5
2	*Catolaccus ater*	45	13.23	D5	91.66	C4	12.13	W5
3	*Oomyzus sokolovskii*	30	8.82	D4	58.33	C3	5.14	W4
4	*Tetrastichus sp.*	17	5	D3	50	C2	2.5	W3
5	*Trichomalopsis peregrinus*	16	4.70	D3	50	C2	2.35	W3
6	*Trichomalopsis acuminatus*	14	4.11	D3	41.66	C2	1.71	W3
7	*Trichomalopsis albopilosus*	14	4.11	D3	50	C2	2.05	W3
8	*Trichomalopsis micropterus*	9	2.64	D3	41.66	C2	1.10	W3
9	*Mesochorus anomalus*	7	2.05	D2	41.66	C2	0.85	W2
10	*Mesochorus facialis*	7	2.05	D2	33.33	C2	0.68	W2
11	*Dibrachys cavus*	7	2.05	D2	41.66	C2	0.85	W2
12	*Mesochorus vittator*	6	1.76	D2	41.66	C2	0.73	W2
13	*Mesochorus orbitalis*	4	1.17	D2	33.33	C2	0.39	W2
14	*Gelis bicolor*	2	0.58	D1	16.66	C1	0.09	W1

We have encountered in our researches situations in which, in some cabbage crops attacked by ***Plutella xylostella***, the percentage of parasitism was particularly high - 80% -90% and even over 90%, without intervening with parasitoids raised in the laboratory and launched in nature in view of biological control. On the contrary, although ***Plutella xylostella*** was strongly parasitized, without realizing an ecological control, the farmers intervened with insecticides ravaging the cabbage crops. The effect was not so much the destruction of the pest but of the useful fauna (entomofauna), the interventions with chemical weapons becoming true ecological crimes. We realize that we cannot intervene in an ecosystem without knowing what is the state of the biocoenosis (structure and functionality); otherwise our interventions are blind and particularly harmful [25].

What impresses us in this biocoenotic complex is the presence of a large number of secondary parasitoids, which limit the beneficial action for the human economy, the limitation of the populations of ***Plutella xylostella.*** If we look at the relationships among the species of this complex through the economic interests of man, we will consider that, indeed, the secondary parasitoids have a negative role, as we have argued before. If we do the analysis taking into account the **"interests"** of the biocoenotic complex, we will understand the true ecological function of the secondary parasitoids.

We have put into discussion several types of trophic networks characteristic for the biocoenotic complexes of the species ***Plutella xylostella*** to understand what a biocoenotic complex of parasitoid type represents.

An arranged agro-system of the type of vegetable garden or of the cabbage crops, is particularly complex. The characteristic biocoenosis of this agro-system is made up of all the species that are living in that space (biotope): the crop plants form the producers together with the weeds that survive to the agricultural works. The producers, be they cabbage, cauliflower, onion, tomatoes, etc., become the target of the phytophagous consumers that prefer one species or another, or even more. By their presence, the zoophagous consumers (predators and / or parasitoids) set up themselves and begin to control the populations of the phytophagous consumers, saving the respective crop from being compromised (destruction).

Each plant species is accompanied by a complex of phytophages, and those of swamps, swamps of entomophages of various degrees. It is very difficult or virtually impossible to pursue such a biocoenotic complex in its entirety. But, you can study a cultivated plant (or spontaneous) with its whole complex of natural enemies.

It is as if you would extract a biocoenosis from a bigger biocoenoses that you can follow from a didactic point of view. In this sense, we have individualized the complex of parasitoid species that controls the existence of ***Plutella xylostella***. In other words, we have separated a biocoenosis of parasitoid type, which can serve as a model in understanding of this type of biocoenoses and not only.

We have mentioned in the previous pages that a biocoenosis does not represent only a sum of species, more or less incidentally associated, but a complex of species that depend in their existence on each other and the whole they form. The functional structure of a biocoenosis of any kind is not rigid, not fixed in time and space. This structure is dynamic; some species enter the complex and others come out. Where do they come from and where do they go? They come and go into the big biocoenosis, from which I have extracted these fragments. A 2-3 hectare cabbage crop in a locality can be conceived, functionally as an agroecosystem. Such crops can be also found, round about and at smaller or larger distances, at 2-10 to 15 km or more. This does not mean that they are completely isolated. The mobility of the adults is amazing. If in an isolated cabbage crop attacked by ***Plutella*** we found a parasitic percentage of 90%, or even 100%, that does not mean that ***Plutella*** was extinct as a species. In their dynamics, the females of ***Plutella***, once again cover the cabbage crop even with generations of the respective year.

We often remain contradictory by the large number of accidental species in a trophic network. We must not be surprised. These are found in large biocoenosis preferring other host species. They can be found as dominant or eudominant species in the cabbage crops from other localities or other areas. As I said, it represents the reserve army of the biocoenotic complex.

In our researches over four decades, we found a perpetual dynamics of parasitoid biocoenoses, a continuous change of their functional structure, without the whole of being affected in ensuring of its integrity.

We might think that this is an evolution of this type of parasitoid biocoenosis. I thought wrongly. Certainly, the parasitoid biocoenoses too have a certain evolution during the geological time. What we have surprised here is not a process of evolution, but certain stages or stages in their ontogeny. It is a continuous change that leads to the maturation of biocoenosis, i.e. at the **climax** stage. A mature biocoenosis does not have the **"interest"** to lose some species and to create a state of out of balance.

Let us suppose that in the Big Island of Brăila, where cabbage has been not cultivated for 3-4 decades, this plant is re-cultivated and that the nearest cabbage crops are 15-20 km away. At first, the cabbage culture works very well, not being attacked by phytophagous insects, in this case by ***Plutella xylostella*.** As this species has a very high dynamics and it can even migrate over long distances, it can also established in this crop. The attack of the larvae can increase from one generation to the next if in the cabbage crop do not appear primary parasitoids. The prosperity of the ***Plutella xylostella*** population can put into danger the cabbage crop, especially in spring, when the larvae attack the top of the plantlets.

We must imagine that some primary parasitoids have arrived in the Big Island of Brăila. Having a large biomass of host larvae, their populations increase from one generation to the next.

The intervention of the primary parasitoids greatly save the cabbage crop by reducing the attack of the phytophagous species. The effectiveness of the primary parasitoids can become very high, and the larvae of ***Plutella*** can be parasitized in proportion of 80% - 90%, as we have often found in our researches in some crops in Moldova. The species of primary parasitoids endanger the existence of the phytophage. The biocoenotic system has its mechanisms designed to ensure natural equilibrium among the species of the complex. One of such mechanisms is the intervention of the secondary parasitoids. We were able to find not only the gradual increase in the number of secondary parasitoids, but also the increase of their effectiveness. This increase can cause an imbalance among species. In this situation another mechanism, capable of restoring the ecological equilibrium is put into operation. This is the **buffer system** intervention.

All this could happen provided that man does not interfere with the chemical weapon in order to control the injurious species.

By putting into operation all the necessary mechanisms to restore the ecological equilibrium, the biocoenosis can reach its maturity, that is to the **climax** stage.

The trophic networks presented by us represent stages in the ontogenesis of these parasitoid biocoenoses.

Further on we want to surprise a few stages in the ontogeny of a parasitoid biocoenosis.

-The appearance and the prosperity of the species of producer (host plant);

-The installation of the phytophagous species (primary consumers);

-The appearance of the danger of compromising the crop species of host plant as a result of the attack of phytophages;

-Intervention of primary parasitoids;

-The prosperity of primary parasitoids and the risk of elimination of the phytophagous species;

-Intervention of secondary parasitoids;

-The prosperity of secondary parasitoids and the risk of appearance of biological lack of balance;

-Intervention of the buffer system and the restoration of ecological balance;

-Attaining at the climax of the parasitoid biocoenosis.

This would be the natural development of the ontogenesis of a parasitoid biocoenosis in the absence of some anthropogenic impacts.

The emergence of the danger of harvesting the host plant species as a result of the attack of phytopathogens;

You cannot remain unimpressed by the complexity of trophic networks in the colonies of aphids. They are like of some plants that work in full, but they do not present output. The complex network of parasitoids and hyperparasitoids, along with the buffer system, has a very low effect on the colonies of aphids. It resembles a complex aggregate that functions, but it is not coupled with the mass it would be working on. Everything happens because of the anthropogenic impact manifested by using the chemical weapon in the pests control.

In such biocoenotic complexes put by us into discussion, as far as aphids colonies are concerned, the producers are the crop plants: ***Brassica oleracea*** var. ***capitata*** L., and the endives - ***Cichorium intibus*** L. Ssp. ***sativum*** (D.C) Janchen var. Foliosum Neg.

The phytophagous consumers (primary) are the species of **Aphidae**: ***Brevicoryne brassicae*** L. and ***Uroleucon cichorii*** Koch.

The primary parasitoids are different species of **Aphidiidae**; it follows secondary, tertiary and quaternary parasitoids (Figures 12 and 13).

The trophic networks have cyber-structures that, through the feed-back mechanisms, should not allow the exponential development of a species within the biocoenotic complex.

Let us imagine such a trophic network like a complex aggregate formed by several compartments well connected to each other. Following the functionality of this aggregate, we find that the first two compartments (of the producers and of the phytophages) do not work, as if they were not coupled to the whole aggregate. We notice this deviation because we find that the effect of the aggregate operation does not manifest in the first two components too. It is as if the aggregates would start working from the primary parasitoids level. Beginning from here, the trophic network, through its functional structure, does not allow the exponential development of some species.

This phenomenon happens due to the fact that, in the case of aphid colonies, the buffer system does not cover the phytophages too, as is the case with the populations of Plutella and Pieris, and not only.

As I presented earlier, in the colonies of aphids,the buffer system is formed of tertiary parasitoids which can action also as secondary and or quaternary parasitoids, but never as primary parasitoids.

In this way, the producer and phytophages do not function any more with the whole entire cybernetic self-regulation system.

In the other cases, the buffer system is formed of primary parasitoids that can act also as secondary parasitoids, which allow that the cybernetic self-regulating system to function entirely.

In other words, as a result of man's imprudent intervention, by using the chemical weapon in order to control some species injurious to plants (in the present case the aphids), natural cyber mechanisms designed to ensure the natural balance, they can no longer function normally.

If we have understood this aspect in the case of parasitoid biocoenoses connected with the colonies of aphids, then we can explain the imbalances that occur in other types of parasitoid biocoenoses too.

We cannot be wrong if we assert that nature is intelligently structured and that the biological adaptation implies, in the present case, a continuous restructuring of the trophic network of the biocoenotic complex, in such a way that the whole will face the new conditions imposed by the environment and especially by the anthropogenic impact.

The nature economy works without major losses in the situation in which nature is not subjected to some severe anthropogenic pressures. Cybernetic mechanisms of self-regulation of populations ensure the avoidance of the exponential multiplication of species to the detriment of others.

Biocoenotic complexes are particularly dynamic in time and space and adaptable to the concrete conditions offered by environment. In this way, we explain the diversity of the trophic networks in some of the parasitoid biocoenoses.

As we have already noticed, we need to make a capital difference in what it concerns the economy of man and nature.

Understanding these aspects, we must radically change our behaviour in what it concerns the control of pests of crop plants. We do not work with an isolated species, but with characteristic biochemical complexes with certain functional structures[29, 30].

The so-called specialists in controlling pests do not see, but the crop plants and pests, for them there is no entomophagous entomofauna, which falls into the category of natural enemies of pests and which have a special role in keeping natural balance; Simplifying these things, these "**specialists"** act shrubs in the biocoenotic complexes, with serious consequences both for human health and nature.

If we understand that no species lives alone, isolated, but it depends on its existence on the interrelationships it establishes with the species of the whole complex, then the data of the problem change. By interpreting biosemiotically the species, we have to accept that this is a swarm of swarms, which are part of a larger swarm, which is the biocoenosis, and this is a constituent part of the biosphere [27, 28]. Just thinking this way, we realize that we cannot intervene in the biocoenotic complexes with chemical weapons or even with biological struggle, if we do not really know what is the state of the biocoenosis and what are the concrete relationships among species.

It is necessary that, in controlling pest insects, to come with a new concept, that of using entomophagous (parasitoid and/or predatory) biocoenoses in order not to cause major imbalances in nature.

It is not about raising such biocoenoses in the laboratory and launching them in nature, but not intervening in a biocoenosis without a competent ecological analysis in order to establish its real state.

Conclusions

In the present paper we aim to present the role of entomophagous biocoenoses (parasitoid and/ or predatory) in maintaining natural balance.

On basis of over more than four decades research, in order to identify the pest insects and their natural enemies from the vegetable crops, we have succeeded to accumulate sufficient data on the structure and functionality of the entomophagous biocoenoses and their role in maintaining the natural balance when nature is not subjected to some serious anthropogenic pressure.

By examining the parasitoid complexes that limit the populations of some lepidopteran species and the aphids injurious to some crop plants, we have been able to understand that, in nature, each species depends on its existence on the interrelationships it establishes with the other species according to the ecological principle – **everything depends on everything.**

On the basis of our research, we must state that we cannot afford to act in nature in order to control some pests without making a pertinent ecological analysis to surprise the real state of the biocoenosis.

We consider that, in controlling plant pests, we must move from the concept of knowledge of the pest species to the concept of knowledge of the biocoenotic complex, in which the species carries out its existence and the attack.

It is necessary to use a new concept in pests control, that of using of entomophagous biocoenosis in order not to affect the natural equilibrium and so strongly shaken.

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