



THE PRIMARY AND SECONDARY PARASITOIDS RELATIONSHIPS IN THE PARASITOID COMPLEX BELONGING TO THE LEPIDOPTERA DEFOLIATORS IN THE CABBAGE CROPS

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SYNOPSIS

During the years of 1998 to 2001, the eggs, larvae and pupae stages of the Lepidoptera defoliator species were collected from the cabbage crops of the South Eastern region of Romania (*Pieris brassicae* L., *Pieris rapae* L. – Pieridae; *Plutella xylostella* L. – Plutellidae; *Mamestra brassicae* L., *Autographa gamma* L. and *Helicoverpa armigera* Hbn. – Noctuidae) in order to obtain parasitoid species.

The paper presents the interaction among the parasitoids belonging to the parasitoid complex which limitates the lepidopteran defoliators in the cabbage crops. There were identified 27 primary parasitoid and 13 hyperparasitoid species. New host-parasitoid relationships were found out for science and for Romania. The dynamics as well as the interrelationships established among the parasitoid species are emphasized in the present paper.

INTRODUCTION

The international scientific literature quotes over 65 species of parasitoids of the *Pieris brassicae* L., *Mamestra brassicae* L. and *Autographa gamma* L. eggs, larvae and pupae, over 45 for *Helicoverpa armigera* Hbn., over 25 for *Pieris rapae* L. (Aubert, 1978, Atanasov & co., 1981, Velicani & co., 1982, Talitkii & Kuslitkii, 1990, Tobias & co., 1995) and a great number of parasitoid species (over 100) for *Plutella xylostella* L. (Goodwin, 1979, Fitton & co., 1992).

For the Romanian climate conditions, the studies of the parasitoid species' assemblage that attack lepidoptera defoliators in the cabbage crops were made, primarily in the Moldavian area, 30 years ago (Mustata & Andriescu, 1972-1973, Mustata, 1973, Andriescu & co., 1974-1975, Andriescu, 1982, Mustata, 1992, Pisica, 2001). All these studies showed a successful natural biological control of Lepidoptera species through the primary parasitoid species whose efficiency wasn't limited by secondary parasitoid.

The environment has been degraded due the decades of high pesticide application and of the intensive agriculture, causing serious damage to the structure and function of the ecosystems. Also, the present lack of the pest management and the ignorance of the parasitoid complex role represented reasons to start our studies on the current situation of the parasitoid biocenosis' evaluation.

In the year 1998, we have been initiated a study to identify the current situation of the parasitoid assemblages that limits the Lepidoptera population in the cabbage crops from Romania. In this project, we published different papers about quantitative and qualitative analyses of the parasitoid complex for each one from those 6 identified Lepidoptera species (Costea & co., 2002, Patriche & co., 2005, Patriche & co., 2006).

The main goal of this paper is to analyse the assembly of all parasitoid complexes, the relationship between primary parasitoids, hyperparasitoids and their host preferences, too.

METHODS

The study regarding the parasitoid complex which limits the population of Lepidoptera species, defoliators to cabbage crops in the south-east of Romania, was carried out between 1998 - 2001 from 33 collecting sites and 54 collecting dates.

6 Lepidoptera species: *Pieris brassicae* L., *Pieris rapae* L., (Pieridae), *Mamestra brassicae* L., *Autographa gamma* L., *Helicoverpa armigera* Hub. (Noctuidae), *Plutella xylostella* L. (Plutellidae) have been collected as eggs, larvae (except the first-stage) and pupae but their presence has also been identified based on specific parasitoids found on plants. Therefore 7627 larvae, pupae and parasitoids cocoons and 8349 eggs were collected. Our fieldwork samplings were made mostly in the crops situated in the neighbourhood of natural ecosystems or in the non-chemical treated control areas.

In laboratory, different species of parasitoids have been reared from hosts and the species composition and their abundance were determinate.

RESULTS AND DISCUSSIONS

We identified in our studies on the cabbage crops a total number of 27 primary parasitoid species and 13 secondary parasitoid species belonging to the 6 defoliator Lepidoptera species (Table 1, 2).

Plutella xylostella presented the greatest assemblage of parasitoid species (9 primary parasitoid species and 10 secondary parasitoid species) followed by *Pieris rapae* (8 primary parasitoid species and 6 secondary parasitoid species) and *Pieris brassicae* (5 primary parasitoid species and 2 secondary parasitoid species) (Table 1, 2).

Only 4 primary parasitoid species from the total number of 27 parasitized more than one host species while 5 hyperparasitoid species from 13 ones parasitized two until six primary parasitoid species. The remaining species were identified as primary or secondary parasitoids only in a single host (Table 1, 2).

Among the primary parasitoid, *Trichogramma evanescens* was polyphagous species in the eggs of the *Pieris brassicae*, *Pieris rapae*, *Mamestra brassicae* and *Autographa gamma*. Every one from three species - *Hyposoter ebeninus*, *Cotesia rubecula* and *Compsilura concinnata* – had parasitized two primary parasitoid hosts, decreasing the Pieridae population.

There are 5 species of polyphagous hyperparasitoids; among these, *Baryscapus galactopus* was reared from six primary parasitoid species belonging to *Pieris brassicae*, *Pieris rapae* and *Mamestra brassicae* (Table 2). It is noticed the great number of new primary parasitoid-hyperparasitoid relationships: there are recorded 19 new relationships from all 27 (Table 2).

Oomyzus sokolovskii was reared as primary and secondary parasitoid, too (Table 1, 2).

Table 3 indicates a direct relationship between the dominance of the host species and the number of the parasitoid species throughout the four years. The most relevant example is the *Plutella xylostella* species whose dominance of 79.5% in the year 2000, attracted 8 primary parasitoid and 10 hyperparasitoid species complex while in the first two study years (1998 - 1999), no secondary parasitoid species were reared.

The Pieridae damage was predominant among those 6 pests Lepidoptera species in the cabbage crops for the specified period, except for the year 2000 when *Plutella xylostella* had a peak of attack. This dominance of the Pieridae species determined a relatively constant number of the parasitoid species belonging to *Pieris brassicae* and *Pieris rapae* during the years of 1998 - 2001 (Table3).

Regarding the primary parasitoids, the species that played a major role in the natural control were characteristic to a certain type of host (figure 1). For example, the species *Cotesia glomerata* represented the dominant species that parasitized the *Pieris brassicae* larvae, while the species *Diadegma semiclausum* represented the dominant primary parasitoid species for the *Plutella xylostella* larvae.

Cotesia rubecula and *Hyposoter ebeninus* had a major role in the limitation of the *Pieris rapae* population and a small influence in the decrease of the *Pieris brassicae* population, too.

Concerning the secondary parasitoids, *Baryscapus galactopus* attacked, almost exclusively, the six primary parasitoid species populations related to Pieridae and *Mamestra brassicae* (Table 1). This hyperparasitoid species diminished the role of the primary parasitoid belonging to the Pieridae defoliators in the cabbage crops, especially, on the *Pieris rapae*. For this host species, the hyperparasitoids' activity had a negative effect on the efficiency of the primary parasitoid species, diminishing constantly the action of the primary parasitoids, during the four years of study, with an

average of 46.4% for the primary parasitoid *Hyposoter ebeninus* and with an average of 34.1% for *Cotesia rubecula* (figure 1).

Contrary with this situation, a great diversity of the secondary parasitoid, similar to the hyperparasitoid of the *Plutella xylostella* species, couldn't decrease the impact of the primary parasitoid complex. In our opinion, that situation is caused by the species competition.

Table 1 - The list of the primary and secondary parasitoid species reared in the Lepidoptera species, defoliators in cabbage crops in the south-east of Romania

		Pieris brassicae	Pieris rapae	Plutella xylostella	Mamestra brassicae	Autographa gamma	Helicoverpa armigera	Number of host Lepidopterasp ecies
Primary parasitoid species								
	Ichneumonidae							
1.	Diadegma semiclausum Hellén, 1949			✓				1
2.	Diadegma fenestrata Holmgren, 1860			✓				1
3.	Diadegma brevispinis Thomson, 1887					✓		1
4.	Hyposoter ebeninus Gravenhorst, 1829	✓	✓					2
5.	Hyposoter didimator Thunberg, 1822						✓	1
6.	Diadromus subtilicornis Gravenhorst, 1829			✓				1
7.	Thyraeella collaris Gravenhorst, 1829			✓				1
8.	Netelia silantjewi Kokujev, 1899				✓			1
	Braconidae							
9.	Rogas rossicus Kokujev, 1898					✓		1
10.	Macrocentrus collaris Spinola, 1808				✓			1
11.	Microchelonus contractus Nees, 1816			✓				1
12.	Microgaster mediator Haliday, 1834			✓				1
13.	Cotesia plutellae Kurdjumov, 1912			✓				1
14.	Cotesia rubecula Marshall, 1885	✓	✓					2
15.	Cotesia glomerata Linnaeus 1758	✓						1
16.	Apanteles appellator Telenga, 1949			✓				1

	Chalcidoidea							
17.	<i>Brachymeria femorata</i> Panzer, 1801		✓					1
18.	<i>Pteromalus puparum</i> Linnaeus, 1758		✓					1
19.	<i>Copidosoma truncatellum</i> Dalman 1820					✓		1
20.	<i>Euplectrus cacoeciae</i> Ferrière, 1941				✓			1
21.	<i>Oomyzus sokolovskii</i> Kurdjumov, 1912			✓				1
22.	<i>Trichogramma evanescens</i> Westwood, 1833	✓	✓		✓	✓		4
	Diptera - Tachinidae							
23.	<i>Voria ruralis</i> Fallen, 1810					✓		1
24.	<i>Compsilura concinnata</i> Meigen, 1824	✓	✓					2
25.	<i>Phryxe vulgaris</i> Fallen, 1810		✓					1
26.	<i>Exorista larvarum</i> Linnaeus, 1758		✓					1
27.	Diptera - Muscidae				✓			
No.	primary parasitoid species / Lepidoptera species	5	8	9	5	4	1	

✓ - represents host-relationship new for science

CONCLUSIONS

The assemblage of the defoliator Lepidoptera species in the cabbage crops of the South Eastern Romania consists of 27 primary parasitoid species and 13 secondary parasitoids.

Generally, the primary parasitoids species was specific to a certain type of host. There are only 4 polyphagous species of all 27 primary parasitoids but in secondary parasitoids' case, about a half of the hyperparasitoids was identified as polyphagous species. The primary parasitoid, *Trichogramma evanescens*, attacked the eggs of the four Lepidoptera species and the hyperparasitoid *Baryscapus galactopus* had the major role in limiting six primary parasitoids' populations.

Our investigations show that number of primary parasitoids decrease in comparison to the research carried out 30 years ago, especially for Pieridae and Noctuidae species, remaining the key species only. These species had a meaningful efficiency in the natural control of the defoliators' populations.

As well, it is noticed the hyperparasitoid actions and the numerous (19) new recorded primary parasitoid-hyperparasitoid relationships that could reduce the impact of the primary parasitoids on defoliator Lepidoptera populations.

Table 2 - The list of the secondary parasitoid species reared from different primary parasitoid in the Lepidoptera species

No	Hyperparasitoid species	Pieris brassicae			Pieris rapae		Plutella xylostella			Mamestra brassicae	Number of host species
		Primary parasitoid species									
		Hyposoter ebeninus	Cotesia rubecula	Cotesia glomerata	Hyposoter ebeninus	Cotesia rubecula	Diadegma semiclausum	Cotesia plutellae	Apanteles appellator	Euplectrus cacaoeciae	
	Ichneumonidae										
1.	Gelis bicolor Gravenhorst, 1829							✓			1
2.	Mesochorus anomalus Holmgren, 1858							✓			1
	Chalcidoidea										
3.	Eurytoma infracta Mayr, 1904				✓						1
4.	Dibrachys cavus Walker, 1835						✓				1
5.	Pteromalus semotus Walker, 1834					✓	✓	✓	✓		4
6.	Trichomalopsis submarginatus Thomson, 1878	✓									1
7.	Trichomalopsis acuminatus Graham, 1969						✓				1
8.	Trichomalopsis sp. A					✓	✓				2
9.	Trihomalopsis sp. B					✓	✓	✓			3
10.	Trichomalopsis sp. C						✓				1
11.	Catolaccus ater Ratzeburg, 1852					✓	✓	✓			3
12.	Baryscapus galactopus Ratzeburg, 1844	✓	✓	✓	✓	✓				✓	6
13.	Oomyzus sokolovskii Kurdjumov, 1912							✓	✓		2
	No. of hyperparasitoid species / Lepidoptera species	2			6		10			1	

✓ - represents host-relationship new for science

Table 3 - The relationship between the dominance of the host species and the number of parasitoid species during the years 1998-2001

1998				1999				2000				2001			
Lepidoptera species	Lepidoptera population dominance (%)	No. of primary parasitoid species	No. of secondary parasitoid species	Lepidoptera species	Lepidoptera population dominance (%)	No. of primary parasitoid species	No. of secondary parasitoid species	Lepidoptera species	Lepidoptera population dominance (%)	No. of primary parasitoid species	No. of secondary parasitoid species	Lepidoptera species	Lepidoptera population dominance (%)	No. of primary parasitoid species	No. of secondary parasitoid species
Pieris rapae	39.5	5	3	P. rapae	41.1	4	3	P. xylostella	79.5	8	10	P. brassicae	41.3	3	1
Pieris brassicae	38.03	4	2	P. brassicae	29.4	4	1	P. rapae	8.9	5	3	P. rapae	39.3	6	3
Plutella xylostella	13	3	-	M. brassicae	14.5	3	-	P. brassicae	8.8	3	-	P. xylostella	15.6	6	2
Mamestra brassicae	8.5	2	-	P. xylostella	12.7	6	-	M. brassicae	2.1	3	-	M. brassicae	2.8	1	1
Autographa gamma	0.9	-	-	A. gamma	1.7	2	-	A. gamma	0.4	1	-	A. gamma	0.9	4	-
Helicoverpa armigera	0.08	-	-	H. armigera	0.6	-	-	H. armigera	0.3	1	-	H. armigera	0.1	-	-

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