THE EVOLUTION OF HARMFUL ENTOMOFAUNA IN CERTAIN AGRICULTURAL CROPS, UNDER THE PEDOCLIMATIC CONDITIONS OF THE WESTERN AREA OF THE CENTRAL MOLDAVIAN PLATEAU, ROMANIA

Elena TROTUȘ[1], Raluca ZAHARIA[2], Paula-Lucelia PINTILIE[3], Roxana-Georgiana AMARGHIOALEI[4], Alexandra-Andreea BUBURUZ[5]

Abstract. *The harmful entomofauna of winter rapeseed crops, monitored between 2000–2024 at Secuieni Agricultural Research and Development Station-SCDA, recorded average population densities ranging from 1,207 to 3,510 individuals/m². The highest abundance was observed during the early development stages of the crop—germination, emergence, and rosette formation—followed by budding/flowering. Lower values were recorded during the phenological stages of pod formation, stem elongation, and maturation. The pests belonged to six systematic orders, with the order Coleoptera being predominant (64–72% of all collected specimens). The carabid beetle (Carabidae) community in rapeseed crops included 14 species from 6 subfamilies, with annual variations. The subfamily Pterostichinae dominated in terms of diversity (42.87%), while Harpalinae had the highest number of individuals (46.91%). The species Harpalus aeneus had the highest proportion (36.08%), and Calathus melanocephalus the lowest (0.21%). Based on these studies, it can be concluded that the pest entomofauna was represented by 18 to 25 species, while the beneficial entomofauna consisted of 10 to 14 species, with average densities ranging from 301 to 637 individuals/m².*

Keywords: rapeseed, pests, ecological parameters, entomofauna

DOI 10.56082/annalsarsciagr.2025.2.56

1. Introduction

Situated in the western sector of the Central Moldavian Plateau, a region characterized by rugged, predominantly hilly terrain with numerous depressions, Secuieni Agricultural Research Station (SCDA Secuieni) serves, through the

[1]Senior Researcher I, PhD, Full member of The Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu-Şişeşti", Field Crops Section, Associate Member of Academy of Romanian Scientists. (e-mail: etrotus@yahoo.com)
[2]PhD student, "Ion Ionescu de la Brad" Iași University of Life Sciences, Iași, Romania. (e-mail: raluca.zaharia@iuls.ro)
[3]Researcher II, PhD, Secuieni Agricultural Research and Development Station, Secuieni, Neamț County, Romania.
[4]Researcher, PhD, Secuieni Agricultural Research and Development Station, Secuieni, Neamț County, Romania (e-mail: georgyana_roxana96@yahoo.com)
[5]Researcher III, PhD, Secuieni Agricultural Research and Development Station, Secuieni, Neamț County, Romania (e-mail: alexandra_andreea_83@yahoo.com)

practical application of its research outputs, the administrative territories of Neamț and Bacău counties and northern Vrancea. This area falls within the broader belt of hills and plateaus on the eastern flank of the Eastern Carpathians.

Cropping systems in the region are relatively diverse; however, the largest cultivated areas are devoted to wheat, maize, rapeseed, sunflower, forage crops, and root crops.

Successful crop establishment—particularly for rapeseed, maize, and sunflower—and the assurance of stable yields depend, assuming full compliance with technological practices, on effective plant protection against harmful organisms. These pests frequently reduce yields by up to 35%, and in some cases losses exceed 60%. [1, 2, 3, 5]

Preventing or mitigating pest-induced yield losses requires: (i) an inventory of the harmful entomofauna; (ii) knowledge of their abundance (ecological parameters) and the timing and mode of attack of dominant species; and (iii) the consequent selection of the most appropriate preventive and control measures. [4, 6, 7, 8, 9, 10, 11].

With these objectives, SCDA Secuieni conducted research to characterize the harmful entomofauna in crops with both extensive cultivated areas and high susceptibility to pest attack—namely rapeseed, maize and sunflower.

2. Materials and methods

Research to determine the harmful entomofauna of agricultural crops in the western part of the Central Moldavian Plateau began in 2000 and has continued uninterrupted to the present, covering a 25-year period.

Observations, records, and determinations comprised the following activities:

• Soil sampling (25 × 25 × 25 cm) prior to sowing and collection of biological material;

• Ground-level assessments from seedling emergence to the rosette stage using a 25 × 25 cm quadrat;

• Sweep-netting from stem elongation to the formation of siliques, capitula, panicles, or cobs, at 10-day intervals;

• Collection of entomofauna using Barber-type pitfall traps and yellow pan traps throughout the vegetation period;

• Sampling from inflorescences, siliques, capitula, cobs, and panicles, followed by collection of the associated entomofauna.

Collected material was analyzed in the laboratory under a stereomicroscope, identified to species and taxonomic order, and logged in an observation register. Subsequently, we calculated:

• Pest species density per square meter or per plant, by crop phenological stage and across the full vegetation period;

• Representative ecological parameters: abundance (A), dominance (D), constancy (C), and the ecological significance index (W).

The resulting data informed the selection of preventive and control measures for harmful insects that exceeded the economic threshold (ET).

This paper presents results obtained for winter oilseed rape.

3. Results and Discussions

For clearer presentation of the results, the period 2000–2024 was divided into three stages: Stage I (2000–2008), Stage II (2009–2018) and Stage III (2019–2024).

Based on observations and measurements, during Stage I (2000–2008) the harmful entomofauna of rapeseed comprised 18 pest insect species, with a mean density across the entire vegetation period of 1,823 individuals m². The highest density—643 individuals m²—was recorded for *Phyllotreta atra,* whereas the lowest—1 individual m²—was recorded for *Melolontha melolontha*.

By phenological stage of rapeseed, the lowest density (33 individuals m²) occurred at plant maturity, and the highest (396 individuals m²) at flowering (Table 1).

Table 1 Harmful entomofauna of rapeseed crops during 2000–2008

No	Species/Order	Mean species density (individuals/ m²)									
		Germination	Seedling emergence	Rosette formation	Stem elongation	Budding	Flowering species	Silique formation	Seed formation	Maturity	Total species
Coleoptera											
1	*Agriotes sp.*	6	5	6	-	-	-	-	-	-	17
2	*Agrostis segetum*	-	5	7	-	-	-	-	-	-	12
3	*Opatrum sabulosum*	3	3	2	-	-	-	-	-	-	8
4	*Melolontha melolontha*	1	-	-	-	-	-	-	-	-	1
5	*Phyllotreta atra*	17	114	234	96	76	56	32	11	7	643
6	*Phyllotreta nemorum*	9	34	41	12	37	29	9	6	-	177

7	*Psylliodes chrysocephala*	2	7	11	3	5	4	3	1	-	36
8	*Entomoscelis adonidis*	-	1	3	2	1	-	-	-	-	7
9	*Ceuthorhynchus napi*	-	-	-	16	15	11	2	1	1	46
10	*Epicometis hirta*	-	-	-	-	5	5	3			13
11	*Meligethes aeneus*	-	-	-	11	114	157	132	17	21	452
12	*Ceuthorhynchus assimilis*	-	-	-	3	27	54	57	5	3	149
13	*Colaphus sophiae*	-	3	5	5	3	-	-	-	-	16
Heteroptera											
14	*Eurydema ornata*	-	-	2	-	7	21	36	-	-	66
15	*Eurydema oleraceum*	-	1	-	-	9	17	10	6	-	43
Hymenoptera											
16	*Athalia rosae*	2	2	7	13	27	36	11	1	1	100
Lepidoptera											
17	*Pieris rapae*	2	4	9	3	6	5	3	-	-	32
Homoptera											
18	*Brevicoryne brassicae*	-	-	-	-	-	1 col.	2 col.	2 col.	-	5
Total per phenophase		42	179	327	164	332	396	300	50	33	1823
Total for the period		1823									

In Stage II (2009–2018), the harmful entomofauna of rapeseed crops increased both in species richness and in the number of individuals per unit area. It comprised 25 pest insect species, with a mean density across the entire vegetation period of 3,510 individuals m².

The highest density (1,444 individuals m²) was again recorded for *Phyllotreta atra*, while the lowest (2 individuals m²), was recorded for *Melolontha melolontha.*

By phenological stage of rapeseed, the lowest density (118 individuals m²) occurred at physiological maturity, whereas the highest (588 individuals m²) was observed at the rosette formation stage (Table 2).

Table 2 Harmful entomofauna of rapeseed crops during 2009–2018

No	Species/Order	Mean species density (individuals/ m²)									
		Germination	Seedling emergence	Rosette formation	Stem elongation	Budding	Flowering species	Silique formation	Seed formation	Maturity	Total species
Coleoptera											
1	*Agriotes sp.*	6	6	5	-	-	5	-			22
2	*Opatrum sabulosum*	3	2	1							6
3	*Melolontha melolontha*	2	-	-							2
4	*Phyllotreta atra*	287	396	374	147	86	80	54	11	9	1444
5	*Phyllotreta nemorum*	54	79	84	51	21	-	11	17	-	317
6	*Psylliodes chrysocephala*	-	5	7	15	10	2	1	-	-	40
7	*Chaetocnema tibialis*	18	36	42	38	18	3	3	9	-	167
8	*Entomoscelis adonidis*	-	5	11	14	10	7	-	-	-	47
9	*Ceutorhynchus napi*	3	7	-	11	16	15	6	3	3	64
10	*Ceutorhynchus pleurostigma*	-	-	3	4	1					8
11	*Ceutorhynchus quadriden.*	-	-	3	3	1					7
12	*Colaphellus sophiae*	-	3	5	7						15
13	*Ceutorhynchus assimilis*	-	-	5	7	7	9	6	9	10	53
14	*Meligethes aeneus*	-	27	36	45	250	380	198	140	96	1172
15	*Ceutorhynchus picitarsis*	-	-	-	2	4	2	1	-	-	-
16	*Epicometis hirta*	-	-	-	-	3	7	3	1	-	14
Heteroptera											
17	*Eurydema ornata*	7	11	7	2						27
18	*Eurydema oleraceum*	-	1	3	1						5
Diptera											
19	*Delia brassicae*	1	2	-	-	-	-	-	-	-	3
20	*Dasineura brassicae*	-	-	-	-	1	3	2	-	-	6
Hymenoptera											
21	*Athalia rosae*	-	-	-	6	11	20	27	1		65

Lepidoptera											
22	*Agrotis segetum*	2	3	1							6
23	*Pieris rapae*	-	-	-	-	2	3	1	-	-	-
24	*Mamestra brassicae*	1	2	1	-	-	-	-	-	-	4
Homoptera											
25	*Brevicoryne brassicae*	-	-	-	-	-	1	-	-	-	1
Total per phenophase		384	585	588	353	441	537	313	191	118	3510
Total for the period		3510									

Stage III (2019–2024). The harmful entomofauna of rapeseed crops comprised 20 pest insect species, with a mean density of 1,207 individuals m² across the vegetation period.

The highest density, 523 individuals m², was recorded for *Ceuthorynchus pallidactylus*, while the lowest, 1 individual m², was observed for *Sitona lineatus L., Oulema melanopa L., Vanessa cardui L., and Eurygaster spp.* (Table 3).

Table 3. Harmful entomofauna of rapeseed crops during 2019-2022

No	**Specie**	**Sep.**		**Oct.**			**Nov.**			**Feb**	**Mar.**			**Apr.**			**May**			**June**			**T**
		II	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	
Coleoptera																							
1	*Phyllotreta atra Goeze*	1	5	1	3	0	0	1	0	6	1	1	7	9	4	7	0	0	0	0	0	0	**46**
2	*Phyllotreta nemorum L.*	2	0	0	1	0	3	2	0	0	0	1	4	10	1	1	0	0	0	0	0	0	**25**
3	*Phyllotreta nigripes Fabr*	4	0	0	2	0	1	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	**11**
4	*Psylliodes chrysocephala L.*	0	30	11	4	10	8	2	6	7	0	1	3	6	0	2	0	0	9	5	15	4	**123**
5	*Baris chorizans Germ*	0	0	0	0	1	3	2	2	0	0	1	2	22	1	3	1	0	0	0	0	0	**38**
6	*Ceutorhynchus assimilis Payk*	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15	20	2	3	0	9	0	**51**
7	*Ceutorhynchus napi Gyll*	0	0	0	0	0	0	0	0	1	3	4	3	8	2	6	3	4	0	0	0	0	**34**
8	*Ceutorhynchus*	0	0	0	1	11	7	2	3	8	2	3	153	229	13	16	47	7	16	0	5	0	**523**

	pallidactylus Marsham																					
9	*Epicometis hirta Poda*	0	0	0	0	0	0	0	0	0	0	0	2	39	19	17	6	0	6	1	5	0	**95**
10	*Meligethes aeneus L.*	0	0	0	0	0	0	0	0	0	2	4	17	30	7	98	10	4	4	0	0	0	**176**
11	*Sitona lineatus L.*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
12	*Oulema melanopa L.*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
13	*Harpalus spp.*	0	0	0	0	0	0	0	0	0	0	1	1	0	2	6	0	0	0	0	0	0	**10**
Homoptera																							
14	*Brevicoryne brassicae L.*	0	0	0	2*	2*	0	0	0	0	0	0	0	0	0	0	0	0	1*	1*	2*	0	8*
15	*Mysus persicae Sulzer*	0	0	0	1*	1*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2***
Lepidoptera																							
16	*Pieris brassicae L.*	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
17	*Vanessa cardui L.*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Heteroptera																							
18	*Eurygaster spp.*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
19	*Lygus spp.*	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	**8**
Hymenoptera																							
20	*Athalia rosae L.*	25	8	4	2	0	0	0	0	0	0	0	0	0	0	0	0	1	7	3	0	0	**50**
Total		32	43	17	17	26	22	9	11	22	8	17	204	354	52	172	87	18	46	10	36	4	1207
*Colonies																							

The harmful entomofauna of rapeseed crops belonged to the systematic orders *Coleoptera, Heteroptera, Diptera, Lepidoptera, Homoptera* and *Hymenoptera.* Owing to its large number of species and individuals, the order *Coleoptera* accounted for the largest share ranging from 64% to 72%—across all three stages in the 2000–2024 period (Figure 1).

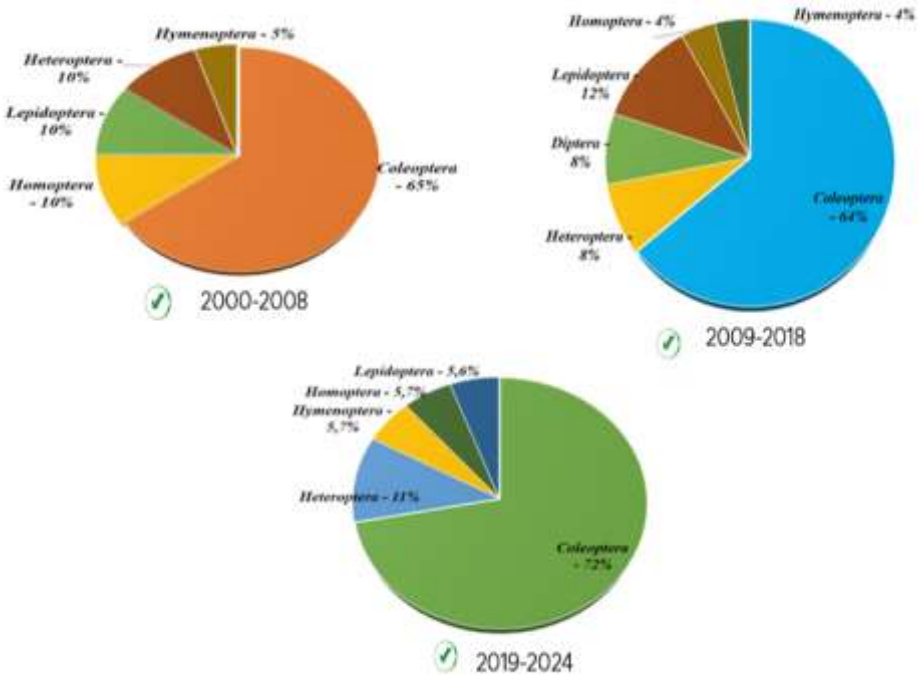

Fig. 1. Proportional representation of the systematic orders to which the collected species belong

Grouping the harmful entomofauna by crop phenophases with heightened susceptibility to insect attack, we found that the largest share across the rapeseed growing season occurred during the interval from seed germination and seedling emergence to rosette formation, ranging from 30% (Stage I, 2000–2008) to 64.8% (Stage III, 2019–2024). This was followed by the budding–flowering period, with shares from 27.6% (Stage III, 2019–2024) to 39.9% (Stage I, 2000–2008). In the remaining periods—stem elongation, silique and seed formation, and seed maturation—the share of entomofauna was much lower (Figure 2).

These findings informed rapeseed production technologies in central Moldavia, where preventive and control measures against key pests were incorporated specifically into the phenophases with the greatest plant susceptibility.

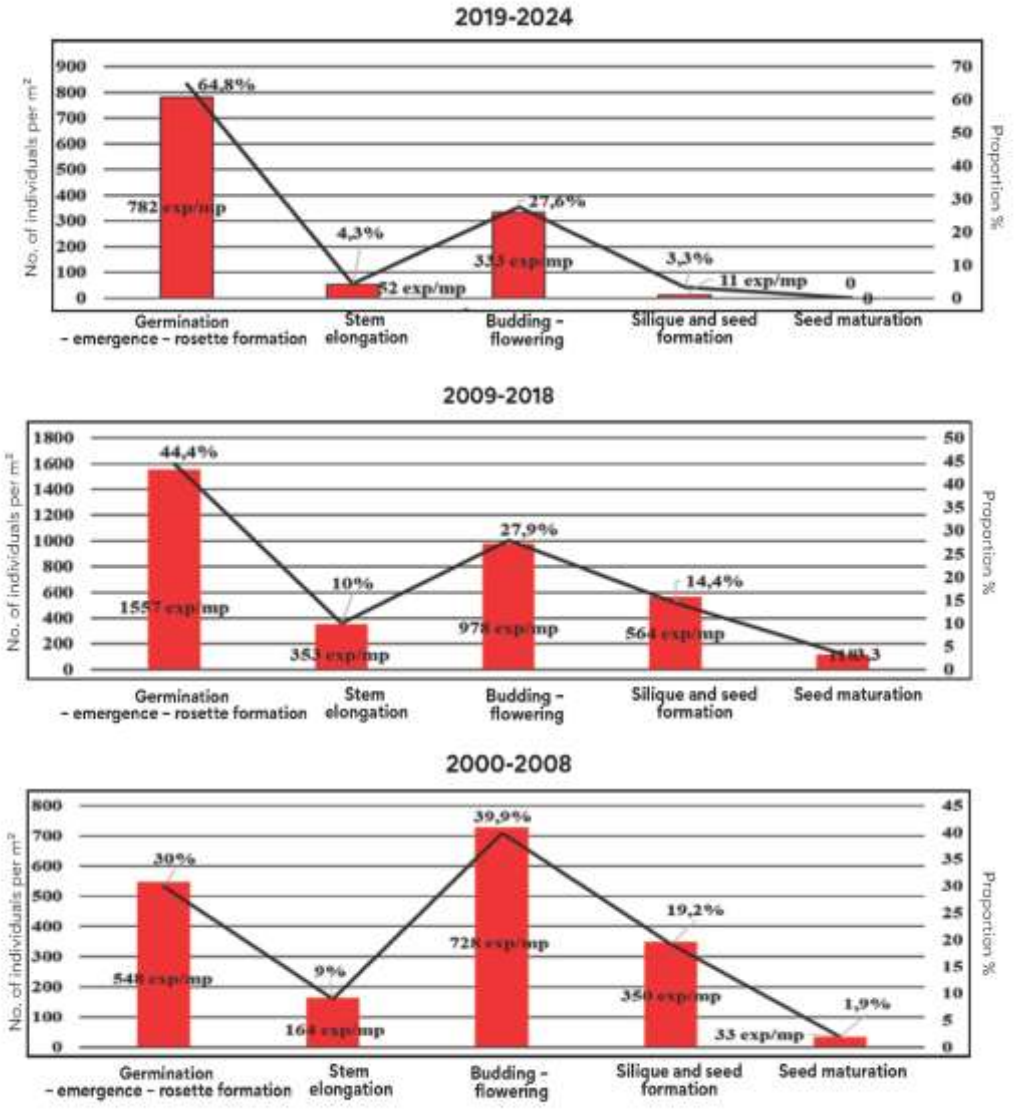

Fig. 2. Abundance of harmful species recorded at different phenological stages of rapeseed

During 2000–2024, a particular focus of the SCDA Secuieni research team was the inventory of beneficial entomofauna in rapeseed crops. Observations and determinations on beneficial entomofauna belonging to the family *Carabidae* collected in rapeseed fields revealed 14 species. The highest proportion was recorded for *Harpalus aeneus* (36.08%), while the lowest was for Calathus melanocephalus (0.21%) (Table 4).

Table 4. Numerical and percentage composition of species and specimens from *Carabidae* subfamilies in winter oilseed rape at Secuieni, 2000–2024

No.	Species name	2000-2008		2009-2018		2019-2024		Annual total	
		No.	%	No.	%	No.	%	No.	%
1	*Harpalus aeneus F.*	193	37.12	128	42.52	205	32.18	526	36.08
2	*Brachynus crepitans L.*	81	15.58	49	16.28	147	23.08	277	19.00
3	*Pterostichus vulgaris L.*	27	5.19	-	-	22	3.45	49	3.36
4	*Carabus violaceus L.*	11	2.12	9	2.99	19	2.98	39	2.67
5	*Harpalus distinguendus Duft.*	29	5.58	31	10.30	38	5.97	98	6.72
6	*Pterostichus niger Schaller*	139	26.73	16	5.32	115	18.05	270	18.52
7	*Cicindela germanica L.*	20	3.85	-	-	15	2.35	35	2.40
8	*Pterostichus rufipes De Geer*	15	2.88	13	4.32	22	3.45	50	3.43
9	*Pterostichus melanarius Ill.*	2	0.37	-	-	5	0.78	7	0.48
10	*Harpalus calceatus Duft.*	3	0.58	-	-	7	1.10	10	0.69
11	*Pterostichus anthracinus Ill.*	-	-	27	8.97	22	3.45	49	3.36
12	*Amara aenea De Geer*	-	-	10	3,32	11	1.73	21	1,44
13	*Calathus fuscipes Goeze*	-	-	16	5.32	8	1.26	24	1.65
14	*Calathus melanocephalus L.*	-	-	2	0.66	1	0.16	3	0.21
Total species		10		10		14		14	
% Total species		71,43		71,43		100,00			
Total individuals		520		301		637		1458	
% Total individuals		35.67	100,00	20.64	100,00	43.69	100,00		100,00

The 14 collected species were assigned to six subfamilies: *Harpalinae, Brachininae, Pterostichinae, Carabinae, Cicindelinae, and Zabrinae.* Based on the number of species recorded in rapeseed crops, *Pterostichinae* accounted for the largest share (42.87%) (see Figure 3), whereas by number of individuals collected, *Harpalinae* had the highest proportion (Figure 4).

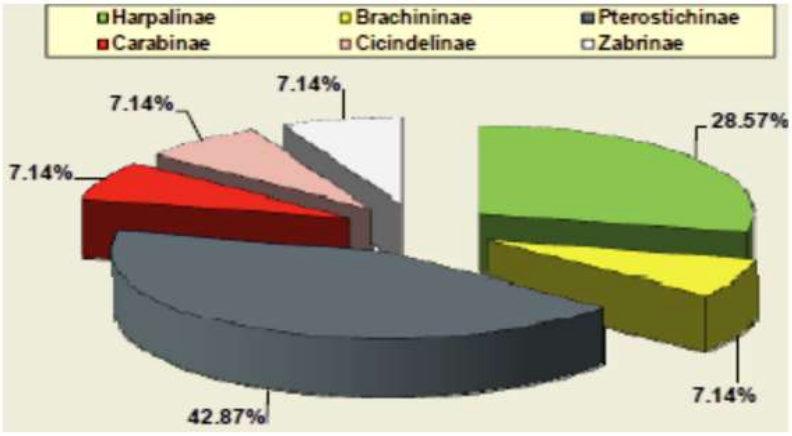

Fig. 3. Proportional representation of Carabidae subfamilies by number of species collected

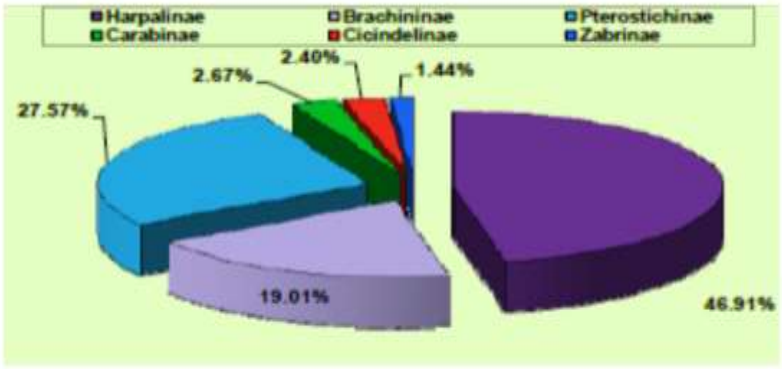

Fig. 4. Proportional representation of Carabidae subfamilies by number of specimens collected

Analyzing the ecological parameters of the beneficial entomofauna, we found:

- Abundance (A) ranged from 3 individuals (Calathus melanocephalus) to 526 individuals (Harpalus aeneus).
- Constancy (C) ranged from 1.85% to 80.25%. Species fell into three constancy classes: 10 species in class C1 (accidental), 2 species in class C2 (accessory), and 2 species in class C4 (euconstant).
- By values of the ecological significance index (W), 10 species belonged to classes W1–W2 (accidental), 1 species to class W3 (accessory) and 3 species to classes W4–W5 (characteristic) (see Table 5).

Table 5. Analysis of ecological indicators for Carabidae species in winter oilseed rape at Secuieni, 2000–2004

No.	Species name	Subfamily	A	C		W	
				%	C1	%	C1
1	*Harpalus aeneus F.*	Harpalinae	526	80.25	C_4	28.9505	W_5
2	*Brachynus crepitans L.*	Brachininae	277	54.32	C_3	10.3020	W_5
3	*Pterostichus vulgaris L.*	Pterostichinae	49	24.07	C_1	0.8091	W_2
4	*Carabus violaceus L.*	Carabinae	39	17.28	C_1	0.4623	W_2
5	*Harpalus distinguendus Duft.*	Harpalinae	98	35.19	C_2	2.3650	W_3
6	*Pterostichus cupreus L.*	Pterostichinae	270	49.38	C_2	9.1449	W_4
7	*Cicindela germanica L.*	Cicindelinae	35	14.20	C_1	0.3408	W_2
8	*Pseudophonus rufipes De Geer*	Harpalinae	50	21.60	C_1	0.7409	W_2
9	*Pterostichus niger F.*	Pterostichinae	7	3.09	C_1	0.0148	W_1
10	*Harpalus calceatus Duft.*	Harpalinae	10	4.32	C_1	0.0296	W_1
11	*Pterostichus anthracinus Ill.*	Pterostichinae	49	21.60	C_1	0.7261	W_2
12	*Amara aenea De Geer*	Zabrinae	21	8.64	C_2	0.1245	W_2
13	*Calathus fuscipes Goeze*	Pterostichinae	24	9.88	C_2	0.1626	W_2
14	*Calathus melanocephalus L.*	Pterostichinae	3	1.85	C_4	0.0038	W_1

Constancy
C_1 - accidental 10 sp.
C_2 - accesories 2 sp.
C_4 - euconstant 2 sp.

W
$W_{1,2}$ - accidental 10 sp.
W_3 - accesories 1 sp.
$W_{4,5}$ - characteristic species3 sp.

The temporal dynamics of harmful and beneficial entomofauna—expressed as mean density per m² over the entire rapeseed growing season and as the mean number of species collected are shown in Figure 5.

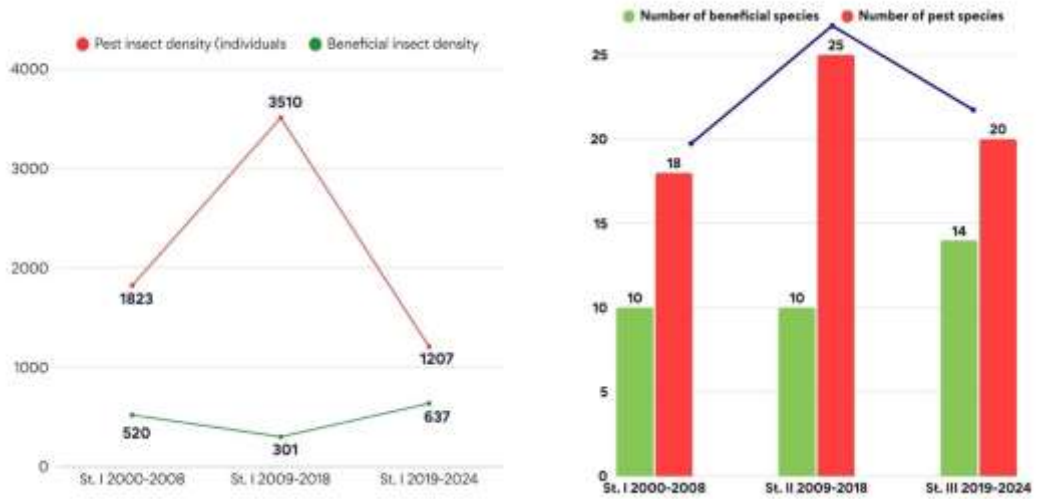

Fig. 5. Dynamics of harmful and beneficial entomofauna in rapeseed crops under the pedoclimatic conditions of the eastern sector of the Central Moldavian Plateau

Conclusions

(1). Over the full growing season, mean densities of harmful entomofauna ranged from 1,207 individuals m² (2019–2024) to 3,510 individuals m² (2009–2018), while species richness varied from 18 (Stage I, 2000–2008) to 25 (Stage II, 2009–2018).

(2). Pest abundance remained broadly stable across periods, peaking during seed germination, seedling emergence, and rosette formation, followed—sequentially—by budding/flowering, silique and seed formation, stem elongation, and physiological maturity.

(3). The rapeseed pest complex comprised species from *Coleoptera, Heteroptera, Homoptera, Hymenoptera, Lepidoptera* and *Diptera.*

(4). *Coleoptera* predominated throughout, accounting for 64–72% of species and individuals.

(5). The carabid coenosis in winter oilseed rape consisted of six subfamilies and 14 species, with interannual variability.

(6). By number of species, *Pterostichinae* contributed the largest share (42.87%); by number of specimens, *Harpalinae* was dominant (46.91%).

(7). Among beneficial taxa, *Harpalus aeneus* had the highest proportion (36.08%), whereas *Calathus melanocephalus* had the lowest (0.21%).

R E F E R E N C E S

[1] Buburuz A.A., Trotus T., Talmaciu M., Pochiscanu S.F., 2013, *Analiza unor indicatori ecologici ai speciilor de insecte daunatoare din culturile de rapita de toamna*, Analele INCDA Fundulea, vol. 81,155.

[2] Buburuz A.A., Trotus E., 2014, *Cunoasterea cenozei de carabide epigee din culturile de rapita in conditiile din Centrul Moldovei*, Analele INCDA Fundulea, vol. 82, pg 289.

[3] Popov C., 2004 a, *Tablou sinoptic insectele dăunătoare din culturile de rapiţă întâlnite în România*. Probl. prot. pl., XXXII (1): 113-118.

[4] Trotuş, E., Trif, V., Mureşan, F., 2002, Date noi privind protecţia culturilor de rapiţă pentru ulei împotriva dăunătorilor specifici, Analele ICDA. Fundulea, LXX: 337-346.

[5] Trotus E., 2007, *Evolutia entomofaunei daunatoare in culturile de rapita din Centrul Moldovei"* „45 de ani de activitate stiintifica a S.C.D.A. Secuieni" – Volum omagial, ed. „Ion Ionescu de la Brad" Iasi, pg. 130-139.

[6] Trotuș E., Naie M., Galani Gh. 2008, *Cercetări privind reducerea atacurilor produse de entomofauna dăunătoare culturii de rapiță la îmbobocire, înflorire, formare a silicvelor și maturarea semințelor*, Analele ICPP București.

[7] Trotuş E., Popov C., Râşnoveanu L, Stoica V., Mureşan F., Naie M., 2009, *Managementul protecţiei culturilor de rapiţă faţă de atacul insectelor dăunătoare*. An. INCDA. Fundulea, LXXVII: 211-221.

[8] Trotus E, Pochiscanu S.F., Naie M.,2015, *Epicometis Hirta Poda (Gandacul paros al florilor), daunator periculos al culturilor de rapita,* Analele INCDA Fundulea, vol. 83, 179-187.

[9] Trotuș E., Mincea C., Dudoiu R., Pintilie P.L., Georgescu E. I., 2019, *Rezultate preliminare privind impactul insecticidelor neonicotinoide, aplicate în tratamentul seminței de rapiță, floarea – soarelui și porumb, asupra entomofaunei dăunătoare și albinelor melifere*, Anale INCDA Fundulea, LXXXVII, 251 – 260.

[10] Trotuș E., Mincea C., Pintilie P.L., Amarghioalei R.G., 2020, *New data on entomofauna harmful to rapeseed crops and the establishment of measures to prevent and reduce attacks,* Romanian Journal for Plant Protection, Vol. XIII, 31-36.

[11] Trotuș E., Pintilie P.L., Amarghioalei R.G., *Protecția culturilor de rapiță de toamnă împotriva bolilor și a dăunătorilor*, Ed. Ion Ionescu de la Brad, Iași.