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THE COMMUNITIES STRUCTURE OF INVERTEBRATE FAUNA FROM RAPE AND ALFALFA CROPS (SINGURENI, GIURGIU COUNTY, ROMANIA)

Cristina FIERA [1]*, Dorina PURICE[1], Sanda MAICAN[1]

*E-mail: cristina.ivanescu@ibiol.ro

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ABSTRACT. The present study has been conducted under a bilateral project between Romania and Republic of Moldova, focusing on knowledge of the invertebrates from rape (*Brassica napus* L.) and alfalfa crops (*Medicago sativa* L.) from Singureni (Giurgiu County, Southern Romania). The communities structure of invertebrates fauna in term of species composition and numerical abundance were analyzed. In total, 15 species of Collembola from seven families and 38 species of Coleoptera from 17 families were identified. *Entomobrya handschini*, *Lepidocyrtus paradoxus, Isotoma anglicana* were abundant in the alfalfa crop and *Hemisotoma thermophyla*, *Protaphorura sakatoi, Orchesella flavescens* (Collembola) were abundant in the rape culture. From Coleoptera Order, *Dermestes murinus, Brachinus crepitans* and *Epicometis hirta* were dominant in the rape crop. *Coccinella septempunctata* and *Gonioctena fornicata* were dominant in the alfalfa. Also, another 385 specimens from different taxonomic groups (Heteroptera, Homoptera, Diptera, Hymenoptera, Thysanoptera, Orthoptera and Araneae) were collected using sweep nets. Some crop pests invertebrates were indicated and the beneficial predators were also revealed.

Key words: Alfalfa; Rape, Numerical abundance; Invertebrates.

REZUMAT. Structura comunităţilor faunei de nevertebrate din culturile de rapiţă şi lucernă (Singureni, judeţul Giurgiu). Studiul s-a realizat în cadrul unui proiect bilateral (România - Republica Moldova) şi a urmărit cunoaşterea faunei de nevertebrate din două culturi agricole: rapiţă (*Brassica napus* L.) şi lucernă (*Medicago sativa* L.), amplasate în localitatea Singureni (jud. Giurgiu). A fost analizată structura comunităţilor de nevertebrate din punct de vedere al compoziţiei specific şi abundenţei numerice. Au fost identificate 15 specii de colembole, aparţinând la şapte familii, şi 38 specii de coleoptere, care fac parte din 17 familii. *Entomobrya handschini*, *Lepidocyrtus paradoxus, Isotoma anglicana* au fost abundente în cultura de lucernă, iar *Hemisotoma thermophyla*, *Protaphorura sakatoi, Orchesella flavescens* (Collembola) au fost abundente în cultura de rapiţă. Din cadrul ordinului Coleoptera, *Dermestes murinus, Brachinus crepitans* şi *Epicometis hirta* au fost dominante în cultura de rapiţă. *Coccinella septempunctata* şi *Gonioctena fornicata* au fost dominante în cultura de

[1] Institute of Biology Bucharest of Romanian Academy, Romania

lucernă. De asemenea, au fost colectate, cu ajutorul fileului entomologic, 385 exemplare de nevertebrate din diferite grupuri taxonomice (Heteroptera, Homoptera, Diptera, Hymenoptera, Thysanoptera, Orthoptera şi Araneae). S-au evidenţiat speciile de nevertebrate dăunătoare şi cele prădătoare, care sunt folositoare culturilor agricole.

Cuvinte cheie: lucernă; rapiţă; abundenţă numeric; nevertebrate.

INTRODUCTION

Agroecosystems have very low levels of biodiversity if we compare them with other types of ecosystems. The relationships between biodiversity and agroecosystem functioning are complex and require clarification for each of the services biodiversity can provide. Their positive effects depend principally on interactions between biotic components or between biotic and abiotic components of the agroecosystem, hereafter referred to simply as biotic interactions (*sensu lato*). These biotic interactions are of interest in agriculture for a number of reasons, including the services they provide through non-chemical pest control and improvements in crop growth conditions (resulting from changes in soil nutrient availability and soil structure (Shennan, 2008).

Data on specific diversity of entomofauna in the various crops in Romania were published by: Manolache and Boguleanu, 1967; Lăcătuşu *et al*., 1981; Voicu *et al.,* 1983; Boguleanu, 1994; Perju and Ghizdavu, 2001; Manole *et al.,* 2009; Bucur and Roşca, 2011; Tălmaciu and Tălmaciu, 2011; Buşmachiu and Bacal, 2012 etc. Cultures of rape and alfalfa in Romania are attacked by a number of pests, causing major damages. Few papers regarding Collembola species from these two crops have been published in our country: Radu *et al.,* 1970; Stan and Coroiu, 1978; Călugăr *et al.,* 1990. The preliminary results of the study of springtails fauna from different crops were published by Fiera (2011).

The aim of our study was to assess the structure of invertebrates associated with studied crops and to establish the most important pests and in the meantime to indicate the beneficial predators.

MATERIALS AND METHODS

Our investigations were conducted in Singureni locality, Giurgiu County, Romania (44°13'48" N; 25°56'55" E), on May 2011, in two crops - alfalfa (*Medicago sativa* L.) and rape (*Brassica napus oleifera* L.).

The entomofauna of the canopy and grass layer was collected using an entomological net of 60 and 30 cm ø, 10 samples were taken, for each sample 50 sweepings of the vegetation was done. The beetle and springtail fauna was captured with Barber traps, 10 unit samples in each site; some specimens from Coleoptera were collected by hand, from the surface of the soil. The traps filled 2/3 with 4% formaldehyde solution were kept in the field three weeks.

The material from Collembola and some families of Coleoptera was identified at species level; the specimens from other taxonomic groups were determined at order level, according to the

basic keys from following systematic papers: Freude, 1976; Fjellberg, 1998; 2007; Kaprus and Pomorski, 2008; Potapov, 2001; Warchałowski, 2003.

RESULTS AND DISCUSSION

Our study revealed a total number of 1263 individuals of Collembola (31,51%), Coleoptera (39,27%) and other taxonomic groups (30,48%), sampled only once from two different crops located in Singureni locality, Giurgiu County. From the insects sampled using sweep nets, the most abundant group of rape culture was Coleoptera (42,6%), followed by Heteroptera (18,6 %) and Diptera (17,8%) and in the other one culture, again Coleoptera (44,3%), followed by Homoptera (21%) and Diptera (16,5%) (*Fig. 1*).

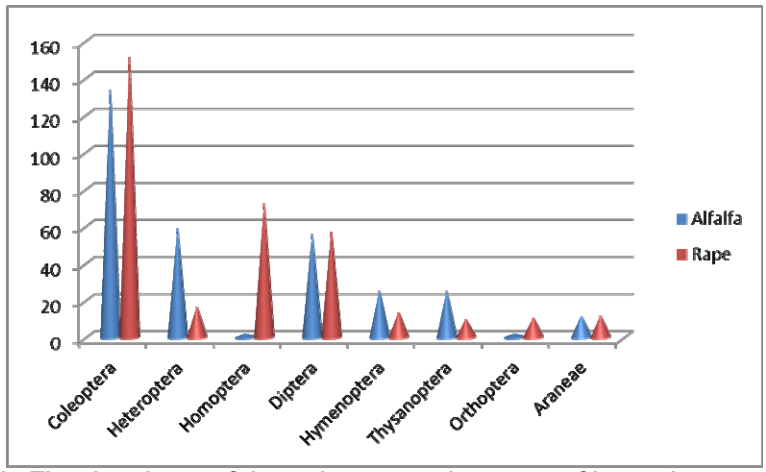

Figure 1 - The abundance of the main taxonomic groups of invertebrates collected by sweepings the vegetation

A total of 398 specimens of Collembola were collected from both crops, which are included at 15 species and seven families, as follows: Entomobryidae (5 genera and 6 species), Hypogastruridae (3 genera and 3 species), Isotomidae (2 genera and 2 species), Onychiuridae, Neanuridae, Tomoceridae and Sminthuridae (each with one genus and one species) (*Table 1*).

10 species of springtails have been identified in the rape culture and 8 species in the other one crop. The species number of Collembola in our study was markedly lower than it has been reported in other studies where this group has been investigated in arable land (Smolis and Hurej, 2001; Lagerlöf and Andrén, 1991). The low number of springtails probably depends on the number of unit samples collected and on the sampling method. As we mentioned at the method section, the springtail fauna was sampled only in one sampling occasion.

Table 1 - The numerical abundance of springtails from crops

Taxa	Rape	Alfalfa
Onychiuridae *Protaphorura sakatoi* (Yosii, 1966)	16	
Entomobryidae *Lepidocyrtus paradoxus* Uzel, 1891	10	67
Entomobrya handschini Stach, 1922	8	81
Orchesella bifasciata Nicolet, 1842	3	
Orchesella flavescens (Bourlet, 1839)	14	
Seira domestica (Nicolet, 1842)	6	29
Heteromurus major (Moniez, 1889)	5	
Isotomidae		
Hemisotoma thermophila (Axelson. 1900)	28	
Isotoma anglicana Lubbock, 1862		40
Neanuridae *Pseudachoruthes* sp.	2	
Hypogastruridae *Hypogastrura vernalis* (Carl, 1901)	9	
Ceratophysella stercoraria Stach, 1963		13
Xenylla sp.		9
Tomoceridae *Tomocerus vulgaris* (Tullberg, 1871)		23
Sminthuridae *Sminthurus viridis* (Linnaeus, 1758)		35
Number of species	**10**	**8**
Number of families	**5**	**5**
Number of specimens	**101**	**297**

Entomobrya handschini, a species common on grass and herbs, but also under bark of deciduous trees (Baquero *et al.,* 2008) and *Lepidocyrtus paradoxus* (Entomobryidae) were the most abundant species from Entomobryidae family in the alfalfa crop. *Isotoma anglicana* (Isotomidae) is another abundant species reported in our study. It was mentioned to be a common species in different open sites under arable management (Potapov, 2001). *Smithurus viridis* (Collembola) is known as important pest of a variety of winter grain crops and pastures in Southern Australia. The predatory mite, *Bdellodes lapidaria* (Acari: Bdellidae), co-occurs with *S. viridis* and is reported to be a biological control agent of this pest (Roberts *et al.,* 2011).

The most abundant and frequent Collembola species from rape culture were: *Hemisotoma thermophyla* (Isotomidae), *Protaphorura sakatoi* (Onychiuridae) and *Orchesella flavescens* (Entomobryidae). The first species is widespread and sometimes can reach high densities and predominate in various sites, usually disturbed (Potapov, 2001). It is known that Collembola represents the main prey of most linyphiid spiders

(Nyffeler, 1999) or carabid beetles in agricultural soils, when other prey is scarce (Bilde *et al.,* 2000).

From Coleoptera Order, a total of 382 specimens were collected from Barber traps, belonging to 26 species and 12 families: Carabidae, Byturidae, Silphidae, Tenebrionidae, Coccinellidae, Curculionidae, Elateridae, Chrysomelidae, Scarabaeidae, Corylophidae, Dermestidae and Staphylinidae (*Table 2*).

Table 2 - The numerical abundances (N), relative abundances (%), frequencies (F%) and average numerical densities (N/s.u.) of the Coleoptera in the alfalfa and rape crops (Barber traps)

Taxa	Alfalfa				Rape			
	N	%	F%	N/s.u.	N	%	F%	N/s.u.
Carabidae								
Pseudoophonus rufipes (De Geer, 1774)	0	0	0	0	8	2,55	33,3	1,33
Pterostichus cylindricus (Herbst, 1785)	5	7,24	33,3	0,56	0	0	0	0
P. nigrita (Paykull, 1790)	0	0	0	0	2	0,64	16,67	0,33
P. madidus (Fabricius, 1775)	0	0	0	0	4	1,27	16,67	0,67
Carabus coriaceus Linnaeus, 1758	1	1,45	11,1	0,11	0	0	0	0
C. glabratus Paykull, 1790	0	0	0	0	8	2,55	16,67	1,33
C. granulatus Linnaeus, 1758	1	1,45	11,1	0,11	0	0	0	0
Amara aulica (Panzer, 1796)	1	1,45	11,1	0,11	1	0,32	16,67	0,17
A. eurynota (Panzer, 1796)	4	5,79	33,3	0,44	13	4,15	33,3	2,17
Cicindela hybrid Linnaeus, 1758	2	2,9	22,2	0,22	0	0	0	0
Calathus rotundicollis Dejean, 1828	0	0	0	0	2	0,64	16,67	0,33
Callistus lunatus (Fabricius, 1775)	2	2,9	22,2	0,22	0	0	0	0
Harpalus anxius (Duftschmid, 1812)	0	0	0	0	5	1,6	16,67	0,83
H. flavescens (Piller & Mitterpacher, 1783)	0	0	0	0	2	0,64	16,67	0,33
H. punctulatus (Duftschmid, 1812)	0	0	0	0	9	2,87	16,67	1,5
Brachinus crepitans (Linnaeus, 1758)	0	0	0	0	56	17,89	33,3	9,33
Trechus rubens (Fabricius, 1792)	0	0	0	0	1	0,32	16,67	0,17
Zuphium olens (Rossi, 1790)	1	1,45	11,1	0,11	0	0	0	0
Byturidae								
Byturus tomentosus De Geer, 1774	10	14,5	44,4	1,11	8	2,55	33,3	1,33
Silphidae								
Silpha obscura Linnaeus, 1758	0	0	0	0	22	7,03	33,3	3,67

Taxa	Alfalfa				Rape			
	N	%	F%	N/s.u.	N	%	F%	N/s.u.
Ablattaria laevigata (Fabricius, 1775)	8	11,6	44,4	0,89	28	8,94	33,3	4,67
Tenebrionidae								
Blaps mortisaga (Linnaeus, 1758)	1	1,45	11,1	0,11	1	0,32	16,67	0,17
Tenebrio sp.	2	2,9	22,2	0,22	0	0	0	0
Coccinellidae								
Coccinella septempunctata (Linnaeus, 1758)	5	7,24	44,4	0,56	0	0	0	0
Coccinella undecimpunctata Linnaeus, 1758	2	2,9	11,1	0,22	0	0	0	0
Oenopia conglobata (Linnaeus, 1758)	1	1,45	11,1	0,11	2	0,64	16,6	0,33
Curculionidae	19	27,53	66,67	2,11	1	0,32	16,67	0,17
Elateridae	1	1,45	11,1	0,11	1	0,32	16,67	0,17
Chrysomelidae	1	1,45	11,1	0,11	61	19,48	16,67	10,17
Scarabaeidae	1	1,45	11,1	0,11	0	0	0	0
Corylophidae	1	1,45	11,1	0,11	0	0	0	0
Dermestidae	0	0	0	0	76	24,32	16,67	12,67
Staphylinidae	0	0	0	0	1	0,32	16,67	0,17
Number of specimens	**69**	**100**		**7,65**	**313**	**100**		**52,18**
Number of species	**15**				**17**			
Number of families	**10**				**9**			

The numerical densities of Coleoptera vary between 0,11 and 2,11 ind./s.u. in the alfalfa crop and between 0,17 and 12,67 ind./s.u. in the rape crop. The index of dominance showed that in the alfalfa crop eudominant were the following families: Curculionidae (27,53%), Byturidae (14,5%), and dominant was Coccinellidae (7,24%), while in the rape crop we found eudominant: Dermestidae (24,32%), Chrysomelidae (19,48%), Carabidae (17,89%) and dominant was Silphidae (8,94%) (*Table 2*). The community structure, according to the constancy classes, differ more between the two studied sites. In the alfalfa crop we have constant - Curculionidae, accessory - Carabidae, Coccinellidae, Silphidae and Byturidae, accidental - Tenebrionidae and in the rape crop, we found only a few accessory families: Carabidae, Byturidae, Silphidae (each with 33,3%), the left families being considered accidental ones (*Table 2*).

In the alfalfa crop we noted the presence of some Coleoptera species which are known as natural enemies of aphids: *Coccinella septempunctata, Coccinella undecimpunctata* and *Oenopia conglobata*. Unfortunately, the last two species were accidental in the local epigeic invertebrate community. On the other hand, in the rape coleopteran community, *Brachinus crepitans* and *Dermestes*

murinus are remarkable as numerical abundance, but not as constancy in the samples.

The following species *Gonioctena fornicata*, *Epicometis hirta*, *Meligethes aeneus* (*Table 3*) and *Amara eurynota* are known as main pest of rape and alfalfa crops (Manolache and Boguleanu; Lăcătuşu *et al.,* 1981; Öberg *et al.,* 2011). We notice the presence of predatory species, *Carabus glabratus*, which was eudominant in terms of their density number and frequency in the rape crop. In the alfalfa crop we also identified *Pterostichus cylindricus* and *Callistus lunatus*, these two species are known as predatory invertebrate epigean fauna.

Table 3 - The numerical abundance of Coleoptera collected by entomological net

Taxa	Alfalfa	Rape
Coccinellidae		
Coccinella septempunctata (Linnaeus, 1758)	16	10
Propylaea quatuordecimpunctata (Linnaeus, 1758)	1	1
Oenopia conglobata (Linnaeus, 1758)	1	2
Chrysomelidae		
Chaetocnema semicoerulea Koch, 1803		5
Cassida prasina Illiger, 1798		1
Gonioctena fornicata Brüggemann, 1873	7	
Scarabaeidae		
Epicometis hirta Poda, 1761		34
Valgus hemipterus (Linnaeus, 1758)		2
Cerambycidae		
Pedestredorcadion pedestre (Poda, 1761)		1
Neodorcadion bilineatum Germar, 1824		1
Nitidulidae *Meligethes aeneus* Fabricius, 1775		9
Cantharidae *Cantharis rustica* Fallén, 1807		2
Cantharis livida Linnaeus, 1758		1
Buprestidae *Anthaxia nitidula signaticollis* (Krynicky, 1832)		1
Melyridae *Malachius bipustulatus* (Linnaeus, 1758)		3
Number of specimens	**25**	**73**
Number of species	**4**	**14**
Number of families	**2**	**8**

In agricultural habitats, carabids feed on many important aphid pests, planthoppers, psyllids and other Homoptera. Relatively little is known about the feeding habits of carabid larvae, but apart from some species of *Harpalus,* which are thought to feed almost exclusively on plant seeds

(Brandmayr *et al.,* 1980), most appear to be mainly carnivorous and probably more voracious predators than the adult beetles (Weseloh, 1988). Omnivorous carabids are apparently opportunists that feed upon the trophic resources which are available in the immediate environment. It has been noted that the services delivered by beneficial predators may depend on the morphological, anatomic or metabolic characteristics of the crop plant, which may facilitate or hinder their activities (Médiène *et al.,* 2011).

CONCLUSIONS

Our study, carried out in two different crops (rape and alfalfa) in Giurgiu County, Southern Romania, has revealed the presence of 15 species of Collembola and 38 species of Coleoptera.

The abundant species Collembola in the alfalfa crop were: *Entomobrya handschini*, *Lepidocyrtus paradoxus* and *Isotoma anglicana*. The species *Hemisotoma thermophyla*, *Protaphorura sakatoi* and *Orchesella flavescens* were abundant in the rape culture.

The species *Dermestes murinus*, *Brachinus crepitans* and *Epicometis hirta* (Coleoptera) were dominant in the rape crop and *Coccinella septempunctata* and *Gonioctena fornicata* were dominant in the alfalfa.

Gonioctena fornicata, *Epicometis hirta*, *Meligethes aeneus* and *Amara eurynota* are known as main pest of rape and alfalfa crops. Also, *Sminthurus viridis* (Collembola) is known as alfalfa pest.

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