SPECIES COMPOSITION OF SPRINGTAILS (HEXAPODA: COLLEMBOLA) FROM SOME CULTIVATED SOILS OF PRAHOVA COUNTY (ROMANIA)

FIERA Cristina

Abstract. The present study was carried out in Prahova County in October 2010, in six sites with cultivated soil, 2 on each type of crop: maize (*Zea mays* L.), lucerne (*Medicago sativa* L.) and a crop of winter oilseed rape (*Brassica napus* (L.)). The species composition and dominance structure of springtail from different crops were analysed. In total, 21 species of Collembola were identified. The most abundant species were different for each crop type. *Folsomia alpina*, a high-mountain forest and alpine species was observed in the lucerne crop, which means that the presence of rare species in agricultural soils represents a valuable indicator of the changes these types of ecosystem undergo under the action of human activity.

Keywords: lucerne, maize, rape, relative abundance, species richness, Collembola.

Rezumat. Compoziţia specifică a faunei de colembole (Hexapoda: Collembola) din soluri cultivate, jud. Prahova (România). Prezentul studiu s-a realizat în judeţul Prahova, octombrie 2010, în şase suprafeţe cultivate, câte două din fiecare tip de cultură: porumb (*Zea mays* L.), lucernă (*Medicago sativa* L.) şi rapiţă (*Brassica napus* (L.)). A fost analizată compoziţia specifică a faunei de colembole, identificându-se speciile dominante pentru fiecare tip de cultură. S-a remarcat o diferenţă cu privire la speciile cele mai abundente din fiecare cultură. *Folsomia alpina,* specie montan – alpină, a fost semnalată într-o suprafaţă cultivată cu lucernă. Prezenţa speciilor rare în agrosisteme reprezintă un indicator al modificărilor acestor tipuri de ecosisteme de către om.

Cuvinte cheie: lucernă, porumb, rapiţă, abundenţă relativă, bogăţie specifică, Collembola.

INTRODUCTION

Soil cultivation is known to reduce the abundance and species richness of soil fauna. The use of high doses of pesticides (especially insecticides and herbicides), mineral fertilizers and intensive farming caused a high decrease of soil fauna in different crops (FRATELLO et al., 1985; SABATINI et al., 1997). It is showed that management practices and type of cultivation had more influence on soil biota than different soil types (FROMM et al., 1993).

Little is known about the composition of springtails species from arable land of Romania, especially from the soils cultivated with maize (POPOVIVI et al., 1977; CĂLUGĂR et al., 1987a, 1987b, 1991; BULIMAR et al., 1991-1992), lucerne (RADU et al., 1970; BULIMAR & HUŢU, 1994) and winter oilseed rape (CĂLUGĂR et al., 1990). Recently, FIERA (2006) has reported a new record for the Romanian springtail fauna: *Hemisotoma orientalis* (STACH, 1947) in a maize crop from Insula Mare a Brăilei, South-Eastern Romania.

The sampling programme was designed first to quantify the differences between the three crop types (maize, lucerne and winter oilseed rape) in terms of species composition of Collembola (this paper; preliminary results) and then to concentrate on the importance of shelterbelts in the maintenance of soil communities and on their dispersal ability to migrate between shelterbelt and adjacent crops.

MATERIAL AND METHODS

Six research sites in arable soils were investigated in October 2010 in Prahova county, 2 on each type crop: maize (*Zea mays* L.), lucerne (*Medicago sativa* L.) and a crop of winter oilseed rape (*Brassica napus* (L.)). Ten random soil samples were collected from each plot using McFadyen core. All soil samples were transported in plastic bags to the laboratory. Extraction was done with modified Berlese-Tullgren funnels at a temperature of 18-23°C for about 7 days (EDWARDS, 1991). The individuals were collected and preserved in 70% ethyl alcohol. Collembola were identified to species level using the most recent keys, as indicated by FIERA (2006).

RESULTS AND DISCUSSIONS

21 species of Collembola were recorded from all the sampling sites (Table 1). The most abundant species from cultivated soils were: *Isotoma viridis* (BOURLET, 1839) and *Isotomurus* sp. (from lucerne), *Proisotoma minuta* (TULLBERG, 1871) and *Sminthurinus elegans* (FITCH, 1863) (from rape), *Protaphorura sakatoi* (YOSII, 1966) and *Parisotoma notabilis* (SCHÄFFER, 1896) (from maize). We were not able to identify at species level the most abundant *Isotomurus* from the lucerne crop (Doftana locality) due to difficulties of taxonomic status of this genus.

The number of Collembola species in our study was markedly lower than it has been reported in other studies about arable land (SMOLIS & HUREJ, 2001; LAGERLÖF & ANDRÉN, 1991). This 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 collembolan fauna was collected only under one sampling occasion. Besides, as Collembola live in leaf litter and on the upper humus layer, in the soil and on the soil surface, on the vegetation, and on water film, no single sampling method collects all species. Combining pitfall traps and soil samples to collect Collembola from rape crops of Austria

may yield a better estimation of the community composition of the sites than one method alone (QUERNER & BRUCKNE, 2010). The authors identified more species in the soil subsamples than in the traps.

Table 1. Species composition of Collembola from arable land of three localities (Prahova county), 2010.
Tabel 1. Compoziția specifică a colembolelor din agrosisteme din trei localități ale județului Prahova, 2010.

No.	Species	Lucerne		Rape		Maize	
		LU1	LU2	WR1	WR2	MA1	MA2
	Hypogastruridae						
1.	*Hypogastrura vernalis* (CARL, 1901)				8.3		
	Onychiuridae						
2.	*Protaphorura sakatoi* (YOSII, 1966)						**40.9**
3.	*Protaphorura octopunctata gr.* BÖRNER, 1901						9.1
4.	*Protaphorura* sp.						18.2
5.	*Onychiurus rectospinatus* STACH, 1922						
	Tullbergiidae						
6.	*Stenaphorura denisi* (BAGNALL, 1935)	10.3					
7.	*Metaphorura affinis* (BÖRNER, 1902)	1.3					
	Isotomidae						
8.	*Proisotoma minuta* (TULLBERG, 1871)	13.8		**53.8**			
9.	*Isotomiella minor* (SCHÄFFER, 1896)	10.3		7.7			18.2
10.	*Isotoma anglicana* LUBBOCK, 1862		8.1			30.8	
11.	*Isotoma viridis* (BOURLET, 1839)		**54.1**	23.1			
12.	*Folsomides parvulus* STACH, 1922		1.3				
13.	*Folsomia alpina* KSENEMAN, 1936		1.3				
14.	*Folsomia candida* WILLEM, 1902	3.4					
15.	*Parisotoma notabilis* (SCHÄFFER, 1896)	10.3	10.8			**69.2**	
16.	*Isotomurus* sp.	**36.2**					
	Entomobryidae						
17.	*Lepidocyrtus violaceus* (FOURCROY, 1785)		22.9				
18.	*Pseudosinella imparipunctata* GISIN, 1953						4.5
19.	*Pseudosinella sexoculata* SCHÖTT, 1902						9.1
	Katiannidae						
20.	*Sminthurinus aureus* (LUBBOCK, 1862)	5.2		7.7	25.0		
21.	*Sminthurinus elegans* (FITCH, 1863)			7.7	**66.7**		
Species richness		**8**	**7**	**5**	**3**	**2**	**6**

Legend: Doftana: 45°22'14"N; 25°44'10"E; crop LU1; Breaza: 45°10'51"N; 25°39'5"E, crops: LU2, MA2; Băicoi: 45°1'48"N; 25°50'43"E, crops: WR1, WR2, MA1; LU - lucerne, WR- winter rape, MA - maize (in the table it is presented the relative abundance of each species).
Legendă: Doftana: 45°22'14"N; 25°44'10"E; cultură LU1; Breaza: 45°10'51"N; 25°39'5"E, culturi: LU2, MA2; Băicoi: 45°1'48"N; 25°50'43"E, culturi: WR1, WR2, MA1; LU - lucernă, WR- rapiță de iarnă, MA - porumb (în table este prezentată abundența relativă a fiecărei specii).

There are several studies dealing with Collembola from different crops. Extremely low densities and species richness of soil fauna, including Collembola communities from cultivated soil are reported in other European countries: Poland (SMOLIS & HUREJ, 2001), Slovak (KOVÁC & MIKLISOVÁ, 1997), UK (FRAMPTON, 1997).

A very interesting species found in the lucerne crop from Breaza locality was *Folsomia alpina*, a high-mountain forest and alpine species (POPTAPOV, 2001). Rare species in agricultural soils represent a valuable potential if conditions changes due to human activities (HÅGVAR, 1994). Other species of Collembola mentioned in a previous study (FIERA, 2006) conducted in a maize crop could be mentioned: *Folsomia quadrioculata* (TULLBERG, 1871)*, F. manolachei* BAGNALL, 1939*, Pseudosinella sexoculata* SCHÖTT, 1902, *Isotoma anglicana* LUBBOCK, 1862*, Parisotoma notabilis* (SCHÄFFER, 1896); the last three species were found in our study, too. At Ploieşti, another locality of Prahova County, in a soil cultivated with lucerne, there were also identified: *Orchesella cincta* (LINNAEUS, 1758), *Seira domestica* (NICOLET, 1842)*, Sminthurinus aureus* (LUBBOCK, 1862) (not included in Table 1).

Arable land represents a good example of competition-free (size-neutral) habitat that support r-selected species (small size, short generation time and high fecundity) (BEGON et al., 1990). The conditions from cultivated soils enable more sensitive species (K-strategist) with lower reproduction capacity to occur randomly and survive in these soils for a short time before the enemies come or other type of disturbance occurs. The Collembola is one of the important prey groups for generalist arthropod predators in agricultural soils and constitutes a considerable proportion of their diets (POLLET & DESENDER, 1989; WARNER et al., 2003).

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REFERENCES

BEGON M., HARPER J. L., TOWNSEND C. R. 1990. *Ecology: Individuals, Populations and Communities*. Blackwell Scientific Publications. New York: 1-945.

BULIMAR F., HUŢU M., CĂLUGĂR M. 1991-1992. *Efectul diverselor tehnici asupra microarthropodelor edafice din subsistemul descompunătorilor.* Lucrările Seminarului geografic „Dimitrie Cantemir". **11-12**: 151-156.

BULIMAR F. & HUŢU M. 1994. *Recherches sur les communautes de microarthopodes edaphiques des Vallees du Prut et de la Jijia*. Factori şi procese pedogenetice din zona temperată. Edit. Universităţii „Al. I. Cuza", Iaşi. **1**: 117-123.

CĂLUGĂR M., RUSAN M., HUŢU M., BULIMAR F., VIŢĂLARIU C., DAVIDESCU G., CATARGIU D. 1987a. *Efectul asolamentului asupra microflorei şi microartropodelor edifice.* Analele ştiinţifice ale Universităţii „Al. I. Cuza" din Iaşi. Biologie. **33**(2): 73 -76.

CĂLUGĂR M., HUŢU M., BULIMAR F., VASILIU N. C. 1987b. *Cercetari ecologice asupra microartropodelor edafice din agrosisteme.* Studii şi cercetări de biologie. Seria Biologie Animală. Edit. Academiei Române **39**(2): 143-153.

CĂLUGĂR M., HUŢU M., BULIMAR F., DAVIDESCU G. 1990. *Testarea efectului unor îngrăşaminte verzi asupra microartropodelor edifice*. Studii şi cercetări de biologie. Seria Biologie Animală. Edit. Academiei Române. Bucureşti. **42**(2): 121-129.

CĂLUGĂR M., BULIMAR F., HUŢU M. 1991. *Implicaţiile gospodăririi solurilor asupra microartropodelor edafice*. Cercetări agronomice în Moldova. Rezultate – Recomandări. USAMV, Iaşi. **24**(1-2): 139-144.

EDWARDS C. A. 1991. *The assessment of population of soil - inhabiting invertebrates*. Agriculture, ecosystems and environment. Elsevier Science. **34**: 145- 176.

FIERA CRISTINA. 2006. *A survey of the colembolan fauna of some agroecosystems in a dike island of the lower Danube floodplain (Insula Mare a Brăilei).* Romanian Journal of Biology - Zoology. Edit. Academiei Române. Bucureşti. **51**(1-2): 27-32.

FRAMPTON G. K. 1997. *The potential of Collembola as indicators of pesticide usage: evidence and methods from the UK arable ecosystem*. Pedobiologia Elsevier Science. **41**:179-184.

FRATELLO B., BERTOLANI R., SABATINI M. A., MOLA L., RASSU M. A. 1985. *Effects of atrazine on soil microarthropods in experimental maize fields*. Pedobiologia. Elsevier Science. **28**:161-168.

FROMM H., WINTER K., FILSER J., HANTSCHEL R., BEESE F. 1993. *The influence of soil type and cultivation system on the spatial distributions of the soil fauna and microorganisms and their interactions.* Geoderma. Elsevier Science. **60**(1-4): 109-118.

HÅGVAR S. 1994. *Log-normal distribution of dominance as an indicator of stressed soil microarthropods.* Acta Zoologica Fenica Finnish Zoological and Botanical Publishing Board. **195**: 71- 80.

KOVÁC L. & MIKLISOVÁ D. 1997. *Collembolan communities (Hexapoda, Collembola) in arable soils of East Slovakia.* Pedobiologia. Elsevier Science. **41**: 62-68.

LAGERLÖF J. & ANDRÉN O. 1991. *Abundance and activity of Collembola, Protura and Diplura (Insecta, Apterygota) in four cropping systems.* Pedobiologia. Elsevier Science. **35**: 337-350.

POLLET M. & DESENDER K. 1989. *Prey uptake in subdominant, small to medium-sized carabid beetles from a pasture ecosystem.* Mededelingen Van de Faculteit Landbouwetenschappen Rijksuniversiteit Gent. **54**: 809- 822.

POPOVIVI I., STAN G., ŞTEFAN V., TOMESCU R., HUMEA A., TARTA A., DAN F. 1977. *The influence of atrazine on soil fauna*. Pedobiologia. Elsevier Science. **17**: 209-215.

POTAPOV M. 2001. *Synopses on Palaearctic Collembola: Isotomidae.* Abhandlungen und Berichte des Naturkundemuseums Görlitz. **73**(2): 1-603.

QUERNER P. & BRUCKNE A. 2010. *Combining pitfall traps and soil samples to collect Collembola for site scale biodiversity assessments.* Applied Soil Ecology. Elsevier Science. **45**(3): 293-297.

RADU V. G, ROGOJANU V., GRECEA A., DAN F. 1970. *Dinamica faunei colembolelor din câteva tipuri de sol şi culturi din jurul Clujului*. Studii şi cercetări de biologie. Edit. Academiei Române. Bucureşti. **19**(2): 277- 301.

SABATINI M. A., REBECCHI L., CAPPI C., BERTOLANI R., FRATELLO B. 1997. *Long-term effects of three different continuous tillage practices on Collembola populations.* Pedobiologia. Elsevier Science. **41**:185-193.

SMOLIS A. & HUREJ M. 2001. *Comparative characterization of Collembola species composition of oil seed rape and winter wheat fields near Wroclaw (Poland),* Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo. **409**(78): 129-137.

WARNER D. J., ALLEN-WILLIAMS L. J., WARRINGTON S., FERGUSON A. W., WILLIAMS I. H. 2003. *Mapping, characterisation, and comparison of the spatio-temporal distributions of cabbage stem flea beetle (Psylliodes chrysocephala), carabids, and Collembola in a crop of winter oilseed rape (Brassica napus).* Entomologia Experimentalis et Applicata. Springer Verlag. **109**(3): 225-234.

Fiera Cristina
Institute of Biology of the Romanian Academy, Bucharest
296 Splaiul Independentei, 060031 Bucharest, P.O. Box 56-53, Romania,
E-mail: cristina.ivanescu@ibiol.ro

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