RESEARCHES ON THE EDAPHIC MESOFAUNA FROM SOME GRASSLAND ECOSYSTEMS FROM THE INFERIOR SECTION OF PRUT RIVERSIDE (ROMANIA)

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Abstract

In the present study are pursued some quantitative and qualitative aspects of the edaphic mesofauna in a series of grassland ecosystems and agro-ecosystems of the Prut inferior riverside in order to highlight how the habitat transformations as a result of human actions are reflected on the communities. Inventory and analysis was done in the case of mites (*Gamasida, Oribatida, Actinedida, Acaridida*), insects (order *Collembola* and other insects) and other groups of microartropodes (pseudoscorpiones, myriapods, etc.). Our analysis showed higher densities of microarthropods in grasslands, comparatively with agricultural crops. The most populated grasslands are those located in the flood zone. Between the annual crops, soil cultivated with wheat provides the most favourable conditions for the development of the edaphic microarthropods. The results showed also an abnormally weak population of the lucerne culture. It was established that the qualitative and quantitative features of the edaphic microarthropods communities depends on biopedoclimatic stationary conditions, particularly on humidity factor. The climatic factors from the period before sampling, particularly rainfall affect the communities' features. The results of these researches were compared with the data obtained previously in similar type of ecosystems in North-Eastern Romania.

Key words: (min. 3 – max. 5) edaphic mesofauna, agro-ecosystems, grasslands, Prut.

In the past, the lower sector of Prut riverside was covered with large deciduous forests, especially sessile oak and pedunculate oak, today these remaining only in the form of scattered patches. Grassland areas are not too important, because they were mostly grubbed and used for agriculture. However, some grasslands remained on weak fertile lands from slopes, from the valleys and areas affected by salinity, in general, these areas being unsuitable for agriculture. Grassland vegetation is mostly degraded due to an irrational grazing, erosion process of slope surface reducing the grazing area. Also, in recent decades, many lakes, marshes and swamps of Prut riverside were drained and converted into agricultural land. Once with increasing the Danube, Prut cease leaking, overflow, flooding vast area of its riverside. As a result, many embankments have been performed, the result being the appearance of a striking phenomenon of aridization. Taking into consideration those issues, to assess the functional status of praticolous ecosystems in the area (meadows and cultured lands), the intensity of anthropogenic pressure to which they are exposed, in this work we investigate from a qualitative and a quantitative point of view the edaphic microarthropods fauna as bioindicator of the functional status of soils.

The researches that formed the basis of this work was financed through The National Program for Research, Development and Innovation and are part of a wide range of investigations carried out in various types of ecosystems from Prut inferior riverside.

MATERIAL AND METHOD

The research was conducted in a series of grasslands, as follows:

- Gorban I and Stănileşti I – grazed grasslands located in flood zone (between the dyke and Prut);
- Gorban II and Stănileşti II – grazed grassland, respectively ungrazed both located outside the dyke;
- Cârja – wet grazed grassland.

Also it was selected four types of agricultural crops, situated in Vaslui County, near the localities Râşeşti, Stănileşti, Lunca Banului, as follows:

- Râşeşti (crops of alfalfa, sunflower, corn, wheat);
- Stănileşti (crops of alfalfa, sunflower, corn);
- Lunca Banului (wheat crop).

For each of these stations it has been proceeded at a serial prelevation of the soil samples, each sample with a surface of 100 cm^2. Samples were taken in April 2008 in grasslands of Gorban and Stănileşti and in June 2007 at Cârja. Harvesting of crops was carried out in July 2009, except wheat, from Râşeşti area, which was collected in May.

Extraction of the microarthropods from the samples was made by Tullgren – Berlese method, in the Balogh manner. Then, for the faunistic material subjected to microscopic study, was recorded the abundance of each group sample with sample and calculate the average abundance in individuals/100 cm^2.

RESULTS AND DISCUSSIONS

In the analyzed grasslands the densities of the edaphic microarthropods varied between 101.2 and 395.2 individuals/100 cm^2. Reporting these results to those obtained in a series of pastures located in North Eastern Romania indicates, on average, only slightly higher values (Călugăr, 2005, 2006) (*tab.1*). The best populated is Gorban I station. Next station is wet meadow from Cârja, but this station being analyzed into another sequence of time, the comparison with the other grasslands is possible only under a qualitative aspect.

Table 1

The average density of the edaphic microarthropods

Data Taxonomic group stations	Stations				
	April 2008				June2007
	Gorban I	Gorban II	Stănileşti I	Stănileşti II	Cârja
Oribatida	185.4	67.4	29.4	49.8	118.8
Gamasida	45.0	14.6	29.4	6.4	165.8
Actinedida	31.2	96.8	14.6	9.2	68.2
Acaridida	1.8	1.0	0.6	-	-
Total Acari	263.4	179.8	89.2	65.4	352.8
Collembola	123.6	71.2	129.2	19.2	13.2
Other insects	6.2	16.2	12.8	15.6	8.0
Total Insecta	129.8	87.4	142	34.8	21.2
Other groups	2.0	-	1.0	1.0	0.8
TOTAL	395.2	267.2	232.2	101.2	374.8

Legend: the values represent the average abundance in individuals/100 cm^2

A comparison between grasslands from the flooded zones (Gorban I and Stănileşti I) and grasslands located outside the dyke (Gorban II and Stănileşti II) evidenced that last category shelters a less abundant fauna. Thus, the recorded density of the edaphic mesofauna at Gorban II is 1.47 times lower than at Gorban I and at Stănileşti II is 2.29 times lower comparatively with the situation observed at Stănileşti I (*tab. 1*). The analysis of the ratio mites / insects revealed a domination of the mites in all investigated grasslands, except Stănileşti I where collembolans hold more than ½ from the total mesofauna (*tab. 1*). These insects have a significant representation in station Gorban I (*tab. 1*); the higher weight of the collembolans, insects that are generally represented by species that prefer a high humidity or by very tolerant ones at the variations of soil moisture, indicates the bioedaphic particular conditions of the constant flooded stations.

Between mites it was observed in most cases that oribatids are the group that owns the biggest weight (50-76% from the total mites). The exceptions are represented by the grasslands Gorban II, where actinedids constitute the majority group (54% from mites) and Cârja, where, in the conditions of 2007, the gamasids were dominant (47% of total mites) (*tab.* 1). If in the case of actinedids this situation was found generally in the grasslands of middle sector of Prut riverside (Călugăr, 2005), for the gamasid mites is not a usual one. In the grassland from Cârja gamasid mites, mostly predators (Krantz, 1978), reach values which are 4-26 times higher than in the rest of the analyzed ecosystems; in fact, this group is responsible for the increase of the total number of mesofauna in station Cârja. Perhaps here, gamasid mites found the suitable prey, which leads them to record a real explosion of the population.

Another assumption is that the species *Lasioseius youcefi* Athias Henriot 1959, a dominant species for the gamasid community from Cârja, is a coprophilous element, which find in the grazed grassland trophic source, who led to this extraordinary population growth.

Acaridid mites represent a group of mites which is stimulated by the environments which are rich in nitrous substances. The high representation of acaridids in pastures' soil could be in relation with the increased organic matter from the

herbivore animals' dejections. In the present study it were observed a weak representation of the acaridids, only 0.04-0.6% (Gorban I, Gorban II, Stănileşti I), or even their absence (Stănileşti II, Cârja) (*tab. 1*).

The ratio between the main detritomicrophytophagous groups (oribatids / collembolans – O/C) it is generally supraunit and subunit only in the case of Stănileşti I and Gorban II (*tab. 1*). Between them only at Stănileşti the value of O/C is highly reduced, at Gorban the difference O/C being without significance.

Previous research conducted in grasslands revealed both aspects (Călugăr, 2005; 2006). In many studies this ratio has proved a bioindicator value for the quality and humification stage of various organic substrates (Huţu and colab., 1991, 1992).

Based on the obtained data, on the increased O/C ratio, we can appreciate that in the most analyzed grasslands humification processes prevail; therefore an efficient bioconversion of the necromass occurs.

In the case of agroecosystems the global density is between 2.2-50.4 individuals/100cm^2 (*tab. 2*). The highest densities were observed at wheat and sunflower crops, both from Râşeşti station and the lowest at sunflower and maize crops from Stănilesti (*tab. 2*).

Although the samples were taken in different sequences of time, we remark that the abundance of microarthropods in the case of agroecosystems is much lower than that observed for grasslands (*tab 1., tab. 2)*. Previous studies have shown that some works and agricultural practices have been a real brake on development of soil populations of microarthropods (Călugăr and colab., 1987, Wallwork, 1976). Also, by comparison with the results of some researches conducted in a series of similar cultures, placed in the middle sector and in the Moldavian Plain, significantly lower values for most investigated crops were observed.

Thus a comparative analysis between previously investigated alfalfa crops and that from the present stage showed an abnormal situation for perennial crops, opposed to previous ones; the abundances are now 3.9 to 19 times lower.

Table 2

The average density of the edaphic microarthropods

Data / Taxonomic group / Stations	perennial		annual					
	July 2009						May 2009	
	alfalfa		sunflower		maize		wheat	
	1	2	1	2	1	2	1	3
Oribatida	9.0	12.2	27.4	1.4	7	1.2	25.8	22.2
Gamasida	0.2	4.2	1.8	-	0.2	-	0.6	2.6
Actinedida	6.2	9.6	5.2	0.6	2.6	0.8	1.6	2.0
Acaridida	-	-	0.8	-	-	-	-	0.2
Total Acari	15.4	26	35.2	2.0	9.8	2.0	28	27
Collembola	-	0.4	1.0	1.4	-	-	22	0.8
Other insects	0.6	1.2	0.2	0.8	0.8	0.2	0.4	2.6
Total Insecta	0.6	1.3	1.2	2.2	0.8	0.2	22.4	3.4
Other groups	-	-	-	-	-	-	-	-
TOTAL	16	27.2	36.4	4.2	10.6	2.2	50.4	30.4

Legend: the values represent the average abundance in individuals/100 cm^2 1- Râşeşti. 2- Stănileşti. 3- Lunca Banului

Also for maize the densities observed in this study was 1.5 to 28 times lower (Călugăr, 2007). Higher densities were observed at wheat, both at Râşeşti and Lunca Banului. Sampling from wheat culture from Râşeşti was done previous of the drought period, thus explaining the higher densities comparatively with the rest of the analyzed cultures. In the rest of the cultures, we can assume that edaphic mesofauna was adversely affected by drought. In addition at the time of sampling, alfalfa was mowed. This fact probably had a contribution at intensification of the negative effect of drought on the edaphic mesofauna.

Also, the low abundances from the alfalfa cultures could be a consequence of the fact that these crops were only in the second year of vegetation, so, for the soil communities the time wasn't enough in realizing stability, equilibrium.

From the qualitative point of view, the distribution on systematic groups has shown that the mites hold the majority with 56-97% from the total microarthropods fauna. The only one exception was the sunflower culture from Stănileşti where insects are dominant, but not even here in a very high proportion, being only 52.38% from the total mesofauna. Referring to previous researches made in agroecosystems the same dominance of mites was found (Călugăr, 2007).

Referring to the proportion of different groups of mites is noted that oribatid mites - detritophytophagous mites (Krantz, 1978) - dominate the rest of the groups of mites, without exception.The percentage of representation of oribatid mites varies between 44.85% (alfalfa - Râşeşti) and 92.14% (wheat - Râşeşti) (*tab.* 2). Gamasids and actinedids, mostly predators (Krantz, 1978), develops effective in relation to their prey, consisting mainly in nematodes, collembolans, preadults and eggs of oribatids or other mites.

Among these, actinedids with percentages of 40% in alfalfa (Râşeşti and Stănileşti) and maize (Stănileşti) and below 8% for wheat (Râşeşti and Stănileşti) are located on the second place, after oribatids. Gamasids were absent in samples of soil taken from the culture of sunflower and maize from Stănileşti station and were present in proportions of about 2% at Râşeşti, in maize and wheat and between 1.2 and 16% in the rest.

Into the crops analyzed in this study, acaridids proved to be present only in the culture of sunflower from Râşeşti and in the culture of wheat from Lunca Banului (*tab. 2)*. Taking into consideration the preference for soils in which anaerobic decomposition processes take place, their poor representation in a small number of samples, indicate good soil aeration, aeration due obviously to the agricultural work performed, too (Huţu and colab., 1992).

The ratio between the main detritomicrophytophagous groups – oribatids / collembolans reveals a net predominance of the former; the weak representation of collembolans, insects which are particularly sensitive to dryness, is due to the lack of rainfall. The supraunit ratio oribatids / collembolans show the predominance of the humification in spite of mineralization; the cycling of nutrients is a slower one so, conditions to maintain natural soil fertility occur (*tab. 2*) (Huţu and colab., 1991, 1992).

CONCLUSIONS

The results of the researches on the whole soil mesofauna certify that its physiognomy depends mainly on peculiar stational conditions, as well as on the climatic ones, especially precipitation, from the sampling period.

From the quantitative point of view we can noticed a higher population of the grasslands from the flooded zone, here the densities being almost double than in the unflooded zones.

In the case of agroecosystems the obtained results show an abnormal population of the alfalfa crops. Between the annual cultures, the wheat culture offers the most favourable conditions to the microarthropods development, in the anterior period of drought installation.

As concern the agroecosystems, the density of the microarthropods fauna are significantly lower than those reported for grasslands, so we can appreciate that human intervention have a negative effect on edaphic mesofauna.

In the case of weight of the main edaphic microarthropods groups it was observed the domination of the mites, especially of the oribatids both in grasslands and in agroecoystems.

In the existing biopedoclimatic conditions the ratio between the main detritomicrophytophagous groups – oribatids/ collembolans - was generally supraunit, both in grasslands and in agroecosystems, indicating the predomination of the humification process.

BIBLIOGRAPHY

Călugăr, A., 2005 – *Influenţa aridizării asupra microartropodelor edafice din ecosisteme praticole din lunca Prutului (The influenece of dryness on the edaphic microarthropods from some grasslands in the Prut meadow),* Cel de-al X-lea Simpozion de Microbiologie şi Biotehnologie, 15-16 oct., ed. Corson, Iaşi, p. 471-474.

Călugăr, A., 2006 - *Qualitative and quantitative studies on the edaphic michroarthropods fauna in some grassland ecosystems from Moldavian Plain (Romania),* Studii şi comunicări, Complexul Muzeal de Ştiinţe ale Naturii, Ion Borcea, vol. 21. p. 230-231.

Călugăr, A., 2007 – *Cercetări asupra mezofaunei edafice din unele agroecosisteme din partea de nord-est a României* (*Researches on edaphic mesofauna from some agroecosystems from North Eastern part of Romania)*, Romanian Biological Sciences, vol. V (3-4), p. 92-100.

Călugăr, M., Huţu, M., Bulimar, F., Vasiliu, N., 1987 –- *Cercetări ecologice asupra microartropodelor edafice din agroecosisteme* (*Ecologic researches on the edaphic microarthropodes from egroecosystems*), St. şi Cercet. Biol. Seria Zool., 39 (2), p.143-153.

Huţu, M., Bulimar. F., Călugăr, M., 1991 – *Efectul amendamentelor calcice asupra microartropodelor edafice dintr-o pajişte fertilizată cu îngrăşăminte azotoase (Effect of calcium amendments on edaphic microarthropods from a meadow fertilized with nitrogen fertilizers),* Analele Şt. Ale Univ. Al I Cuza Iaşi, tom XXXVII, s – II - a , Biologie, p. 235-240.

Huţu, M., Bulimar, F., Donose – Pisică, A., Davidescu, G., 1992, *Succesiunea microartropodelor edafice în cursul descompunerii unor resturi organice monospecifice (Sequence of edaphic microarthropods in the decomposition process of some monospecific organic remnants)*, St. cerc. biol., Seria biol. Anim., t 44, nr. 1, Bucureşti, p. 15-24.

Krantz, G. W., 1978 - *A manual of Acarology,* second ed., Oregon State Univ., Book Stores Inc. Corvalis, 509 p.

Wallwork, J. A., 1976 – *The distribution and diversity of soil fauna*, Akad. Press, London, 355 p.