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THE ECONOMIC IMPORTANCE OF THE BIODIVERSITY OF THE INVERTEBRATES FAUNA IN THE CORN CULTURE SOIL IN COPŞA MICĂ (SIBIU COUNTY) ROMANIA

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Abstract

The goal of our researches is in bringing the scientific arguments of the necessity of including the biologic parameters, mainly of the invertebrates in the soil, in the evaluation studies of the impact upon the environment and the national strategies of monitoring of the soils quality. If the chemical analysis measure the quantity of the polluters, the invertebrates in the soil, especially the insects, reflect intensively the anthropologic influences, emphasizing the intensifications or inhibitions of their activity under the stress conditions. The study upon the invertebrates' fauna was carried on in Copşa Mică area (Sibiu County) in the corn agricultural ecosystem. The properties of the soil in this area are strongly changed by the industrial activity as a result of an accumulation of great quantities of heavy metals (lead, cadmium). The researches in this area are a part of a greater study upon the invertebrates' fauna in the corn culture soil of the Sibiu County, researches that took place during 2011-2013. The technology applied in this area is a semi intensive one. For collecting the invertebrates there were used two methods: drilling the soil and pitfall traps. There were identified invertebrates belonging to 4 classes (Annelida, Arachnida, Chilopoda, Insecta) and 11 orders (Haplotaxida, Aranea, Acari, Lithobiomorpha, Geophilomorpha, Collembola, Orthoptera, Heteroptera, Hymenoptera, Coleoptera, Diptera).

Key words**:** *corn culture, invertebrates, soil*

INTRODUCTION

It is a well known fact that the economy can destroy its own systems of support by consuming the fix means of the natural capital. In change of the detachment from the nature of the useful substances by exploitation, the nature gets in return waste materials and residues resulted from production. The soil constitutes the most important and sometimes the most neglected natural source. It imposes that the industrialized society to take into account its properties and the fertilization of the soil as well as its destruction no matter the reason involved. Out researches upon the biodiversity of the invertebrates proves that obeying the ecologic principles the indicators of the soil quality grow, and as a result the crops as well as the number of cattle grow and in this respect the health of people will be ameliorated. Nowadays the trend is of a green economic growth [9].

The fundamental requirement imposed is a change in mentality and appreciation of values. To be aware that planet is our home and that we humans, are a part of nature, that our relation with the environment is important, and that there are no problems in themselves, but indicators of problems related to the design and management of ecosystems, to which we should be able to find solutions [7].

Development based on strategy is a clearly defined approach over the future of a country, a region, an economic sector or area. Increasing complexity of international environment requires the use of development strategies. The strategy is nowadays one of the most used concepts in development theory in economy and besides it [8].

The functionality of the soil is assured by the connections among the micro flora and micro fauna, by the herbivorous, by preys, by the

spontaneous and cultivated flora to which are added the environmental conditions and minerals. The virgin soil, upon which hasn't been yet cut in, is the generous gift of the Mother Nature, its variety permitting more cultures. It is a vivid soil with an extreme active life with a rich supply of water, air and nutritional elements, in which the plants grow, develop without being needed the intervention of the human inputs of synthesis. The soil upon which was cut in by different cultures is under the threatening of the alteration of the existent equilibrium, of the degradation and alienation from its ancestral mission of offering enough and ecological food to the human society. In a non ecological soil, that supposes a soil that "is in comma", so to speak and its biologic life began to disappear. Instead of 30 tones of living beings for each hectare it comes to 3 tones/hectare in the case when the structure of the soil is destroyed. In this case the mineral skeleton becomes dominant and unfavorable for the bios [4].

The complex study of the soil supposes the most appropriate solutions for maintaining the equilibrium and their establishment, again where they have been altered by irrational exploitation. Everything is included in a management based on the conception of a durable maintenance of the quality of the soil, benefiting by the scientific acquisitions and the progresses made in the understanding of the complexity of this vital behavior of our planet.

The main aim of our study is the evaluation of the invertebrates in the soil, especially the entomologic fauna, in order of finding out the taxonomic data on species in the agricultural ecosystem in Copşa Mică. The derived aim is that, which allows the man to become a wise partner of the nature in his triple hypostasis of builder, regulator and consumer in the intensive and traditional agricultural ecosystems.

MATERIALS AND METHODS

The locality where the researches took place was Copşa Mică (Sibiu County). In this locality used to work an industrial platform – Sometra-Carbosin, one of the most important industrial centers in Europe, producing heavy metals, black smoke and other industrial substances.

The surface cultivated with corn in this locality was of 300 hectares in 2012. The shape of the plot was a rectangular one, with a surface of 2 hectares.

The intervals of collecting the biologic material from the soil and on the soil in order of obtaining the spring, summer and autumn samples were as follows: 02.03.-06.03.2012, 0.06-08.06.2012, respectively 03.09-06.09 2012. Due to the favorable climate conditions there was done a supplementary collecting in October during 22.10-26.10.2012.

In the researched corn agricultural ecosystem, the contain of lead (Pb) is situated in the class with very strong charge (558.45 mg/kg) as well as for cadmium (19.10 mg/kg). The soil is very strong polluted with heavy metals [1, 5].

The applied technology was a semi intensive type, on a soil having a medium texture (clay and sand), lacking nutritional substances and characterized by the absence of irrigations. The kind of corn used in the area was Pioneer PR 39D81, having a density of 62.000 plants/hectare.

The collecting methods used were: Pitfall Traps fixed at the level of the soil in which as an appealing and preserver substance was used the formic adelhide 4%; there were used 10 traps, at every 10 m. The collecting time was of 48 hours from installing. The second used method was that of the soil drillings. There were dug 10 holes, having the surface of 25/25cm and the depth of 30 cm. The collected fauna resulted from each drilling was a sample [2].

RESULTS AND DISCUSSIONS

The main sources of pollution in Copşa Mică are due to the industrial activity of two economic agents: SC. SOMETRA S.A., having a profile of nonferrous metallurgy, which before 1990 was considered the biggest unit of this profile in our country (till 1993) and SC. CARBOSIN SA, having a chemical

profile. The activity of these two plants had extremely bad consequences upon the environment, both non biotic and biotic, beginning with the perturbation of the microbiologic activity, respectively of the processes of getting too much ammonite, too much or less nitrate that led to the slowing and sometimes disappearance of humidification processes, in this respect the soil lacking the vivid component. This state of things was underlined by Barbu Horia in a preliminary study done in the Copşa Mică area in 2006 [3].

A thorough research of the soil in Copşa Mică locality, from a soil cultivating, physical-chemical and pollution point of view was done in 2000 by the Professor Mircea Micu, which also presents the correlation with the productivity. His Ph. D Thesis in 2001 entitled "The influence of the pollution upon the soils in Copşa Mică area and its ecologic implications" is a work of reference in this field [6]. One of the general observations of this study refers to the lack of homogenizing of the development level of the same vegetal species on the same subtype of soil. This fact was also noticed by us during the researches done in the analyzed agricultural ecosystem. The vegetation represented by the corn culture is not presented uniform, meaning that some parts are covered with developed plants and other ones with feeble plants or on some parts the plants are lacking totally. This thing assures a level of moderate productivity regarding the agricultural ecosystem. In this case the pollution with heavy metals is to be blamed for diminishing the productivity of the ecosystem.

Another aspect that can't be overlooked is represented by the effect of the black smoke, which presence is felt in the soils in the area. The deposits of black smoke provoke the closing of stomas and prevent the penetration of the sun's rays, affecting strongly the process of photosynthesis and accordingly lead to the lowering of the corn production. The accumulation of the black smoke at the level of the soil led to a stressed pigmentation of this. We noticed the modification of the color of the soil during the drawing of the soil samples and agricultural entomologic fauna in the area. The blacking of the soil was noticed at depth that surpasses the action limit of the machines and equipment for the mechanical works for the mechanical works within the culture technologies.

The pollution of the environment in the Copşa Mică area has a strong negative impact upon the invertebrates in the soil. In the report done by Vădineanu and coworkers in 1991 there was a warning about the disappearance of some species like *Nematoda*, *Enchitreidae* and *Lumbricidae* and the number of species of *Oribatidae* and *Collembola* was reduced with 11-95% unlike the non polluted areas [10].

Our researches regarding the influence of the pollution with heavy metals upon the biodiversity of the agricultural entomologic fauna come to complete the few studies done in this field. So, in the tables 1-8 there are presented the taxonomic structure as well as the quantitative structure of the collected fauna through the two methods in the corn agricultural ecosystem in Copşa Mică during April, May, June, September and October 2012.

Table 1. The taxonomic and quantitative structure of the collected fauna through the soil drilling method Copşa Mică locality (Sibiu County) – April

Order	Numerical Abundance	Relative Abundance
Aranea	2	3,18
Geophilomorpha	1	1,59
Hymenoptera	39	60,32
Coleoptera	22	34,94
TOTAL	63	100,00

Order	Famiy	Genus	Species
4	7	8	7

Table 2. The taxonomic and quantitative structure of the collected fauna through the Pitfall Traps, Copşa Mică locality (Sibiu County) – April

Order	Numerical Abundance	Relative Abundance
Acari	3	3,26
Aranea	21	22,82
Colembola	1	1,09
Orthoptera	1	1,09
Hymenoptera	35	38,04
Coleoptera	30	32,61
Diptera	1	1,09
TOTAL	300	100,00

Order	Famiy	Genus	Species
7	9	10	9

After the analysis of the data from the upper tables there is established that besides the applied technology, of a semi-intensive type, the impact upon the local biodiversity in the corn culture is stressed by the local pollution with heavy metals and black smoke produced by the former plants in Copşa Mică, closed in 1990 because of the aggression upon the environment.

Table 3. The taxonomic and quantitative structure of the collected fauna through the soil drilling method Copșa Mică locality (Sibiu County) - June

Order	Numerical Abundance	Relative Abundance
Haplotaxida	40	33,36
Aranea	3	2,50
Collembola	3	2,50
Hymenoptera	64	53,36
Coleoptera	8	6,72
Diptera	2	1,68
TOTAL	120	100,00

Order	Famiy	Genus	Species
6	11	14	13

Table 4. The taxonomic and quantitative structure of the collected fauna through the Pitfall Traps Copșa Mică locality (Sibiu County) – June

Order	Numerical Abundance	Relative Abundance
Lithobiomorpha	6	4,41
Aranea	10	7,35
Collembola	79	58,1
Orthoptera	8	5,88
Heteroptera	1	0,74
Hymenoptera	19	13,97
Coleoptera	13	9,55
TOTAL	136	100,00

Order	Famiy	Genus	Species
7	12	17	16

Table 5. The taxonomic and quantitative structure of the collected fauna through the soil drilling method Copșa Mică locality (Sibiu County)- September

Order	Numerical Abundance	Relative Abundance
Polydesmida	1	3,45
Scutigeromorpha	2	6,90
Acari	3	10,35
Aranea	8	27,58
Hymenoptera	3	10,35
Coleoptera	12	41,37
TOTAL	26	100,00

Order	Famiy	Genus	Species
6	9	9	8

The soil and the entire area covered by biocenosis of natural and semi-natural type are still affected till nowadays by high dozes, much more above normal of the chemical noxious air. The structure of the biodiversity at invertebrates in the case of the soil drilling presented low values in the first part of the investigations (Table 1) both numerically and from the relative abundance point of view (4 orders, having *Hymenoptera* and *Coleoptera* in leading positions).

Table 6. The taxonomic and quantitative structure of the collected fauna through the Pitfall Traps Copșa Mică locality (Sibiu County) – September

Order	Numerical Abundance	Relative Abundance
Acari	3	3,94
Aranea	21	27,68
Orthoptera	11	14,46
Collembola	22	28,94
Hymenoptera	8	10,52
Coleoptera	11	14,46
TOTAL	76	100,00

Order	Famiy	Genus	Species
6	11	12	11

Table 7. The taxonomic and quantitative structure of the collected fauna through the soil drilling method Copșa Mică locality (Sibiu County) - October

Order	Numerical Abundance	Relative Abundance
Julida	1	0,88
Aranea	7	6,14
Homoptera	51	44,74
Hymenoptera	42	36,84
Coleoptera	11	9,65
Diptera	2	1,75
TOTAL	114	100,00

Order	Famiy	Genus	Species
6	13	16	11

Table 8. The taxonomic and quantitative structure of the collected fauna through the Pitfall Traps Copșa Mică locality (Sibiu County) – October

Order	Numerical Abundance	Relative Abundance
Acari	1	0,88
Aranea	3	2,64
Collembola	14	12,28
Orthoptera	5	4,38
Homoptera	13	11,41
Hymenoptera	72	63,15
Coleoptera	5	4,38
Neuroptera	1	0,88
TOTAL	114	100,00

Order	Famiy	Genus	Species
7	15	16	16

Regarding the epigeous fauna collected by the help of Pitfall Traps, it was richer due to the pioneer vegetation in the area (Table 2).

Regarding the comparison between the level of the fauna and its structure during the entire period of vegetation and the time of the investigations (March-October) in the experimental field in Copşa Mică (Tables 1-8) it was noticed, also, a reduced biodiversity, with only 11 orders, with the domination of the population of *Hymenoptera* and *Coleoptera* Orders (Figure1). The study is not an exhaustive one, a lot of species couldn't be registered taking into consideration the limits of the used techniques, this needing further investigations with better methods.

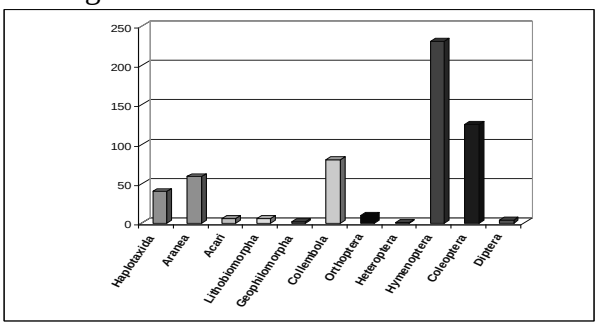

Fig.1 The fauna structure of the invertebrates in the experimental plot in Copşa Mică-Sibiu County-agriculture of semi-intensive type

CONCLUSIONS

The important factor of command, which influences the structure and the dynamics of the invertebrate's fauna in the soil of the experimental investigated culture in Copşa Mică, is the content in heavy metals. Our researches regarding the influence of the pollution with heavy metals upon the biodiversity of the agricultural entomologic fauna confirms the older data (Vădineanu and coworkers, 1991) and come to complete the studies done in this area.

The low biodiversity of the communities of invertebrates was influenced also by the high levels of pressure of the natural command factor, namely the excessive, persistent drought during the last three years, taking into consideration the non irrigated system where was cultivated the corn on the researched experimental plot.

The collected samples through the two specific methods, Pitfall Traps and soil drilling, comprised organisms belonging to the following taxonomic groups: 4 classes: *Annelida, Arachnida, Chilopa* and *Insecta*; 11 orders: *Haplotaxida, Aranea, Acari, Lithobiomorpha, Geophilomorpha, Collembola, Orthoptera, Heteroptera, Hymenoptera, Coleoptera, Diptera*; 65 families; 79 genus; 68 species.

Among the groups of invertebrates that were present in the soil of the experimental corn plot, the arthropods best represented were those from the Class *Insecta* with 6 orders (*Collembola, Orthoptera, Heteroptera, Hymenoptera, Coleoptera, Diptera*), followed by Class *Arachnida* with 2 orders (*Acari* and *Aranea*).

On the other side the groups of invertebrates that were present in the soil of the researched corn culture, the least represented populations were those from Class *Chilopoda* represented by the orders *Lithobiomorpha* and *Geophilomorpha*.

In the same time the biodiversity of the agricultural biocenosis which stood under the toxic impact of the industrial emissions of the former chemical plant in Copşa Mică was affected also by the great quantity of the pesticides whose degree of accumulation in the soil grows annually as a result of the practice of monoculture in the area.

REFERENCES

[1]Antonie Iuliana, Pavel Petronela, Tănase Maria, Sand Camelia, 2012, The Indicators of the Soils and Their Importance upon the Entomologic Fauna in the Corn Culture in Copşa Mică – Axente Sever (Sibiu County), Buletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Agriculture, Romania, vol. 69, nr. 20, pp. 177-181

[2]Antonie Iuliana, Petronela Pavel, Camelia Sand, 2012, Preliminary consideration on the assessment of the agricultural entomologic fauna dynamics in soil, Proceedings of the International Conference "Agricultural and Food Sciences, Processes and Technologies" Agri-Food 20, pp. 25-32, May 10-12, Sibiu

[3]Barbu, H., 2006, Studiu preliminar. Cercetarea şi evaluarea datelor şi studiilor existente privind zona industrială Copşa Mică. Propunere de acţiune în vederea determinării exacte a gradului de poluare precum şi estimarea costurilor acestora. Beneficiar Consiliul Judeţean Sibiu, Romania, pp. 3-12

[4]Berca, M., 2011, Tehnologii ale agriculturii secolului XXI, in „Agrotehnica. Transformarea modernă a agriculturii", Romania, Ed. Ceres,

Bucuresti, cap.1, pp 49-78
[5]Lăcătușu, R., Lăcătușu Anca-Rovena, 2010, Evolution of heavy polluation from Copșa Mică, Scientific Papers, USAMV Bucharest, Romania, Series A, vol. LIII, pp. 85-92
[6]Micu, M.O., 2001, Influenţa poluării cu metale grele asupra solurilor aluviale din zona Copşa Mică, Judeţul Sibiu, Teză de doctorat, Universitatea „Transilvania", Braşov, Romania
[7]Simtion Daniela, Luca Roxana, 2010, Sustainable development in agriculture: long and term aspects, Simpozion Stiintific International, Managementul Dezvoltarii Rurale Durabile, Universitatea de Stiinte Agricole si Medicina Veterinara a Banatului Timisoara, România, pp. 199-207
[8]Simtion Daniela, Luca Roxana, 2010, Development of services in Romania, Conference „Vallis Aurea" Focus on: Regional Development, Croația, pp 1317-1325
[9]Trică Carmen Lenuța, Papuc Marinela, 2013, Creșterea economică verde – premisă pentru dezvoltare durabilă, Economie teoretică și aplicată, Romania, vol. XX, issue 1 (578), pp. 94-104
[10]Vădineanu A., H. Frumosu, V. Ciolac, Speranța Ianculescu, P. Marcuță, C. Ilinoiu, P. Weber, R. Lăcătușu, M. Toti, V. Naghi, T. Calameț, A. Georgescu, V. Cotârla, I. Medrea, Rodica Serban, Mariana Constantinescu, I. Jelev, 1991, Rezultate ale cercetarilor complexe referitoare la starea mediului reflectate în raportul comisiei guvernamentale privind poluarea din zona Copsa Mica, Mediul Înconjurator, Romania, vol. II, nr. 1-2, pp. 35-40