

COSIDERATION CONCERNING ON THE BIOLOGICAL NEOFORMATION RESULTING AFTER SOME LUMBRICIDE ACTIVITIES IN GREENHOUSES SOILS

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Abstract: *Biological neoformations are recent or relict accumulations in the soil mass, resulting in actions performed by the vegetal or animal organisms. They can be easily distinguished in the pedogenetic horizons of the profile, according to color, shape and chemical composition. The constitution of these neoformations is influenced by the physical and chemical properties of the soil, the use category of the land, the way the soil is exploited, the fertilization system of the plants, the phytosanitary treatments and the agricultural system as a whole. Biogenic neoformations in the soil appear as a result of the action of the animal organisms and plant roots. The biogenic neoformations of animal origin are: the mole channels, the coprolites, the earthworm channels, the larvae nests. The soil survey activity also involves the description of the soil cover plants and of the species of animal organisms (pedofauna) which determined the formation and evolution of the soil. The performed pedological studies frequently mention only the presence of some biogenic neoformations, without presenting the species of organisms which contributed to their formation. We consider that the identification of the species of organisms involved in the formation of the biological neoformations is of vital importance. Earthworm populations develop predominantly in most soils in the tropical and temperate areas. If we take into consideration the soil biomass, earthworms can be considered the prevailing group of invertebrates in most soils. Most earthworms, such as Lumbricus, Eisenia, Eiseniella, Allobophora, Octolasion etc., belong to the Lumbricidae family. The presence of these organisms can be an indicator of the health condition of the soils. Earthworms contribute to the formation of the soil structure, increase its water permeability, stimulate its microbiological activity, and increase the water retention capacity. This paper deals with some criteria for establishing the group of earthworms which determined the formation of the system of galleries also known as earthworm channels.*

Key words: *neoformations, earthworm channels, greenhouses soils.*

INTRODUCTION

Biological neoformations are recent or relict accumulations in the soil mass, resulting in actions performed by the vegetal or animal organisms. They can be easily distinguished in the pedogenetic horizons of the profile, according to color, shape and chemical composition. The constitution of these neoformations is influenced by the physical and chemical properties of the soil, the use category of the land, the way the soil is exploited, the fertilization system of the plants, the phytosanitary treatments and the agricultural system as a whole. *Biogenic neoformations* in the soil appear as a result of the action of the animal organisms and plant roots. The *biogenic neoformations* of animal origin are: *the mole channels, the coprolites, the earthworm channels, the larvae nests*. When conducting pedological studies, during the field phase, the nature of the biogenic neoformations, their distribution and frequency is noted and characterized as part of the morphological description of the profile [i]. We consider that, after presenting the above mentioned aspects, it would be useful to get to know and diagnose the invertebrate species which compose the macro- or megafauna of the soil, and especially those species that are frequently met in particular soils. A considerable influence on the characteristics of the soil is exercised by the invertebrate species that belong to the *Lumbricide* family, the

Ophistopora order, the *Oligocheta* class and the *Anellida* phylum (RADU 1958). These invertebrates, known by the people as *earthworms*, are one of the most important species that contribute to the improvement of soil fertility. The major contribution of earthworms to the improvement of soil fertility is achieved via the impregnation of the covered material with digestive enzymes and intestinal microflora and, after they die, their very bodies are a source of nutritional elements for plants. The resulting channels increase aeration and drainability (and, implicitly, water infiltration in the soil), reduce the degree of compaction of the soil and improve the stability of the structure (BRADY, FILIPOV 2005). The considerable influence of earthworms on soils was also noticed by *Darwin*, who called them *biological ploughs*. The breaking up of the soil was performed by the earthworms long before the cultivation of the soil by the human beings and, implicitly, long before the mobilization of the soil via ploughing. Given the significant practical importance of these invertebrates on the characteristics of the soil, this paper aims at reviewing some aspects related to the field diagnosis of the earthworm categories, met in greenhouse soils, according to a series of aspects of the network channels and to some criteria for the identification of the earthworm species according to some of their morphological traits and to the environment conditions they prefer.

MATERIAL AND METHODS

The soils from glasshouses are characterized by a very large variability of mineralogy chemistry and biology, which are traduced by intense modifications of upper part of soil profile. The field observations were carried out within some solarium located in different pedoclimatical locations. Our studies have focused the biological macrofauna organism represented by *lumbricide*.

The biological material has been removed from the greenhouses soil, at the same time with the establishment of the soil profile. The earthworms have been detected and collected from the soil layer from 0-40 cm depth. The earthworms were not eradicated immediately. They were collected in boxes with moist soil and transported to the laboratory, where they were later washed and destroyed by having been kept in ethyl alcohol 20% for 30 minutes. After this operation, they were examined on the binocular magnifying glass.

In order to determine the species, there have been studied the following morphological characteristics:

- the presence or absence of the hypodermic pigment and its nature;
- the setae disposal;
- the position of the segmented parts and the position of body;
- body dimensions and number of segments;
- the shape of the head;
- he position of the first posterior porus;
- the presence or absence of the glandular areas around the male pori;
- the number of seminal vesicles and of the seminal receptacles.

We have also made a comparison between these characteristics from specimens of the same species, in order to highlight the variations met in the species and to interpret them according to the degradation degree of the soil they were extracted from.

The biological material has been extracted from some location of North East Development Region from Romania. In this paper is presented the main sources of the macrofauna diversity, criteria for the differentiation of genera within the *Lumbricide* family and a short characterisation of some *lumbricide species*.

RESULTS AND DISCUSSIONS

The macrofauna in some greenhouse soils is much diversified, especially in those places with an organic agricultural system. The main sources of the macrofauna diversity are presented in figure 1.

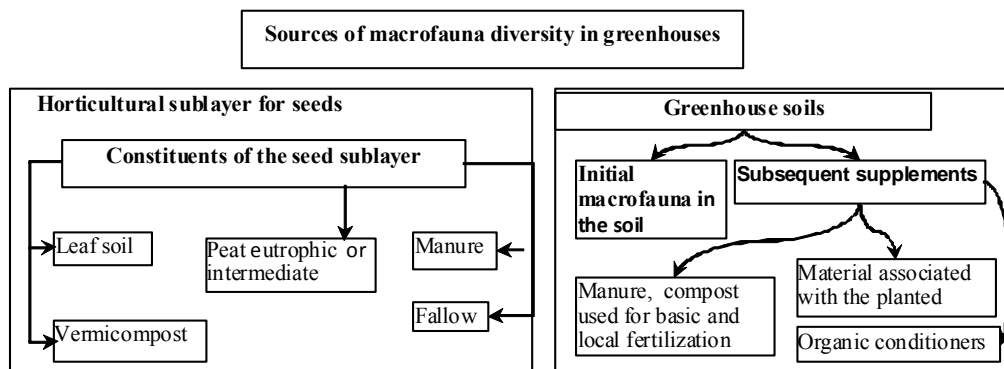


Fig. no. 1 The main sources of the diversity of the macrofauna greenhouse soils (original).

Various species of earthworms can be met in soils, under the rocks, under stumps, under knots, on the slopes of ditches and gutters, in the litter found in various transformation stages, etc. Since we consider that, in order to identify the groups of earthworms, it is necessary to know some aspects concerning their biology and certain morphological traits, we will continue with a concise presentation of the earthworm species that are frequently met in various ecosystems.

Earthworms belong to the *Annelida* phylum, the *Oligochaeta* class, the *Opisthophora* order, the *Lumbricidae* (RADU, 1958). The *Annelida* phylum (*annulus* – ring) includes organisms whose body is made of prostomium, soma and pygidium; the soma is metamerized, being composed of a succession of metameres and rings, arranged successively – in a linear sequence, along the main axis of the body and delimited by the walls which are called *dissepiments*. One of the features of the organisms belonging to the *Oligochaeta* class is that two rows of mobile pores, in a small number, actuated by the muscles, can be found on both sides of the body.

POP V (1947) divides earthworms into two different branches, acting as subfamilies: *Lumbricidae* with porphyrinic pigments and *Lumbricidae* without porphyrinic pigments. The organisms in the second subfamily can have pigments of other colors, apart from red – purple, or may not have any pigments at all. The differentiation criteria of the genera within the *Lumbricidae* family are presented in the 2.

During the survey activity of greenhouse soils, we identified, in some cases, the existence of frequent earthworms channels, although these organisms were not present in the soil.

Lumbricus terrestris (common earthworm) has a cylinder like shape, slightly dorsoventrally flattened, especially at the posterior side. The length of the body varies between 9-30 cm. The number of segments, well delimited via circular grooves, varies between 110-180, depending on the age of the earthworms. The metameric segmentation, general feature of all the *Oligochaeta*, is caused by the fact that, regardless of the environment where they live, they move actively through the body undulations. In the anterior third, the adult earthworms have a thickened segment, called clitellum, which comprises the dorsal part and the lateral sides, of six segments.

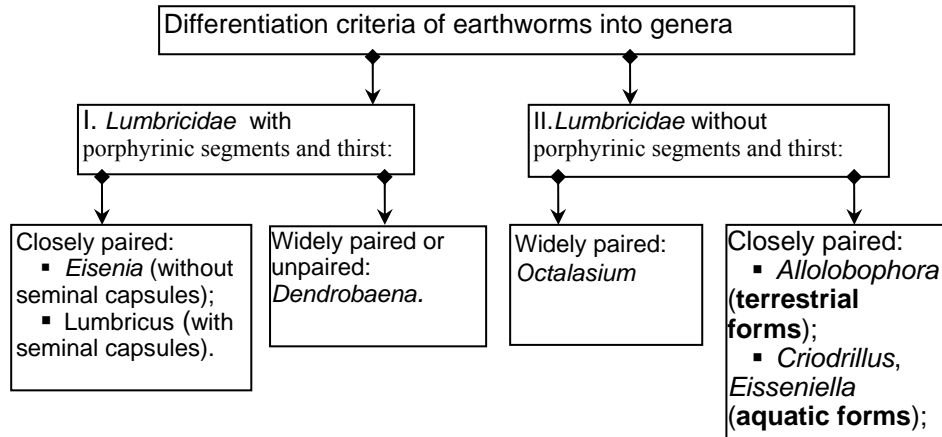


Fig. no. 2 Criteria for the differentiation of genera within the *Lumbricidae* family (processed according to POP, 1947)

The clitellum can be identified due to its different colors and to its dimensions, which are bigger than the adjacent parts. The number of anterior segments, situated before the clitellum, is constant, and, in the post-clitellar region, the number of segments varies with the age.

In case the skin of the animal is excited by various agents (dryness, alcohol, acetic acid, etc.), a strong contraction occurs and the earthworms eliminate, via their dorsal pores, the coelomic fluid which acts as a bactericide, watering and washing the tegument. Breathing is achieved via the vascularized tegument, which is preserved wet due to the environment where they live, through the tegumentary glands and the elimination of the coelomic fluid via the dorsal pores. The (hiemal and estival) diapause of juvenile individuals occurs at a depth of 20-40 cm. The winter rest of the adult earthworms occurs at bigger depths. Earthworms hibernate during the winter in a coiled position, similar to a ball of thread, in the spaces especially created for this purpose. Thus, hibernation occurs at the end of the channels which usually appear to be wider. Since earthworms breathe through teguments, the end of the channels is frequently filled with various seeds or bigger mineral particles. This way, the breathing of these organisms is facilitated and the direct contact with the cold soil is avoided. During hibernation, earthworms lose approximately 50% of the body weight.

Earthworms move by crawling, with the help of the undulating contractions of the body and of the pores, process favored by the well developed muscles. The *Lumbricus* species, as well as other terrestrial species of Oligochaeta, build channels, either by throwing the land on the sides, after entering though the small interstices with the help of the sharpened anterior extremities, or by swallowing the soil material together with organic microorganisms and debris which, subsequently, after the extraction of the necessary nutritional substances, they eliminate through the anal orifice in the post-clitellar region. Earthworms can swallow a large quantity of soil, up to thirty times bigger than their body weight. The excrements they eliminate are impregnated with digestive enzymes.

The *Lumbricus* genus includes purple pigmented earthworms, with tightly paired setae. The clitellum has a saddle-like shape. There are 5 species in Romania.

Lumbricus rubellus has 50-150 mm in length, 4-6 mm in diameter, 95-145 segments, chestnut brown, violet brown or violet red color. The clitellum has a saddle-like shape, and the setae are tightly paired. It is a terrestrial species, living under stones, under fallen leafage and very frequently in deciduous forests.

The *Dendrobaena* genus. As part of this genus, one may note small and medium earthworms, pigmented in various shades of purple, sometimes combined with smoky nuances which possess generously paired or unpaired setae. The clitellar organs occupy a relatively reduced number of segments. It is met on stones, moss, in the wood of rotten trees, in rubbish and occasionally in limnic sediments.

Dendrobaena octaedra. Its dorsal and lateral surfaces have a violet red copper color. These organisms have between 30 and 70 mm in length, and their diameter is of 2 to 4 mm. The segments of the body, ranging between 80 and 100, are not characterized by secondary innelation. The setae are unpaired, and at approximately equal distances. The clitellum is circular or has the shape of a saddle. It is also met in acid and very acid soils, which are restrictive edaphic environments for the majority of earthworms. The variation interval for the pH values of soils rich in these species varies between 3 and 7.8 (CHIRIȚĂ).

The *Eisenia* genus includes small and medium forms of earthworms pigmented in various shades of purple and with intimately paired setae. The clitellar organs consist of a relatively reduced number of segments and their habitat is restricted, as well. The forms lacking in seminal receptacles do not equally possess the puberty ridges, or if possessed, they are poorly developed. More species of earthworms, such as *Eisenia foetida*, *E. parva*, *E. Submontana*, *E. Spelaea*, belong to the *Eisenia* genus.

Eisenia foetida (rubbish worm) includes of organisms with the length ranging between 40 and 130mm, and with a diameter between 2 and 4mm. The number of segments is of 80 – 120. The segments are tri-ring, and the dorsal surface presents violet red pigmented areas. As far as this species is concerned, the pigment is localized only in the middle of each segment, and the segments' margins and grooves separating them are non-pigmented. The body of these species acquires a striped texture. The clitellum is circular. It is found in composts, manure, under stones and in fat soil.

Eisenia submontana is of 80 – 180mm in length, and of 4 – 6mm in diameter. The number of bi-ringed segments varies between 60 and 130. Its dorsal and lateral surfaces present areas colored in violet red or violet brown. If these organisms are introduced in alcohol or formaldehyde, they give off a phosphorescent liquid through their dorsal pores. It is met in mountain forests, in the rotten wood of the fallen trees, and is not very frequent under moss, stones or marshy regions. It efficiently resists floods.

Criteria to recognize the *Lumbricide* genera that existed or activated in the soil are the depth of the galleries and their diameter: the depth of 1÷2m and the diameter of diam.>6mm or diam.<6mm; the depth up to 40 (50cm) (endogeic earthworms; surface of the soil or its superficial part (epigeic earthworms); deposition place of the excrements (surface of the soil or in galleries; orientation of galleries (vertical, slightly oblique or horizontal). Features of the soil: texture (middle t. optimum for the majority of the species); reaction of the soil (optimum-weak and moderately acid r., neutral and weak alkaline r.)

CONCLUSIONS

The macrofauna in some greenhouse soils is much diversified, especially in those places with an organic agricultural system. The main sources of the macrofauna diversity are represented by initial pedofauna, constituent of the seed sublayers, subsequent supplements

. The practical application for this estimation is the establishing of the time of the year when certain varieties and plant hybrids can be cultivated according to their needs from the

photoperiod and the category of the intended production.

Criteria used to recognize the *Lumbricide* genera that existed or activated in the soil are the depth of the galleries and their diameter, deposition place of the excrements (surface of the soil or in galleries), orientation of galleries (vertical, slightly oblique or horizontal).

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