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RESEARCH ON EARTHWORMS COMMUNITY IN AGRICULTURAL CROPS IN THE MOLDOVA PLATEAU

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Abstract: Over the last 40 years, over-cultivation of the soil has led to the loss of about 30% of arable land worldwide destroying the micro- and macro-fauna that provides its life. Earthworms play an important role in soil formation contributing to the composition and functioning of its ecosystem. The purpose of this study was to assess the presence of earthworm species in maize, rapeseed, soybean and barley crops in the Moldova Plateau (North-Eastern Romania) in 2020. The sampling consisted of 15 pits of 25x25x40 cm per crop. Five earthworm species belonging to three genera *Aporrectodea*, *Eisenia* and *Dendrodrilus* were identified. Most earthworms (adults and juveniles) were collected from maize crop (39.63%). In rapeseed crop were collected 30.18% of earthworms and in barley and soybean each 15.09% of earthworms. The most abundant species was *Aporrectodea caliginosa nocturna* with 37.71% of the total adult earthworms. This study reports the first data on earthworm fauna for the Moldova Region in North-Eastern Romania.

Key words: earthworms, *Lumbricidae*, diversity of populations, agriculture crops.

INTRODUCTION

Soil is the most precious natural resource and is the greatest inheritance of mankind. Our connection with soil is based upon the cultivation of soil throughout human history and led to the success of civilizations. During the Green Revolution, an extensive quantity of chemical pesticides and fertilizers were used to boost up crop yield from agricultural land (Datta et al., 2016) which resulted in good yield and productivity. However, during the last four decades, the efficiency of the soil is getting reduced (Gupta et al., 2014; Vanita et al., 2014). Burning crop residues and unsystematic use of agrochemicals depreciate the soil qualities and its natural fertility.

Earthworms are one of the most significant soil organisms having a real potential to maintain the fertility of the soil and thus play a key role in agriculture sustainability. They are also acknowledged as farmer's friend, ecological engineers, biological indicators, intestines of the earth and plowman of the field. Earthworms are extremely important in soil formation, principally through activities in consuming organic matter, fragmenting and mixing it intimately with soil mineral particles to form water stable aggregates. During feeding, earthworms promote microbial activity that accelerates the rate of decomposition and stabilization of humic fractions of organic matter. Some species consume mainly inorganic fractions of soil, whereas others feed almost exclusively on decaying organic matter (Edwards, 2004). All earthworm species contribute in different degrees to the shredding and mixing of the organic and inorganic components of soil and decrease the size of organic and mineral particles (Shrickhande et al., 1951; Joshi & Kelker, 1952).

Earthworm activity makes a significant contribution to soil aeration (Kretzschmar, 1978) by creating channels, particularly in heavy soils, that allow air to penetrate into deeper layers of soil, minimizing the incidence of anaerobic layers. The carbon:nitrogen (C:N) ratio in the organic matter falls progressively during feeding of earthworms. Moreover, most of the nitrogen is converted into the ammonium or nitrate form; phosphorus and potassium are converted into a form available to plants.

Earthworm populations are generally lower in arable land comparative to undisturbed habitats (Chan, 2001). Direct mortality level depends on the severity and frequency of soil disturbance. Cuendet (1983) estimated that 5 to 10% of the earthworm biomass was brought to the surface by plowing, with about 25% of these earthworms mortally wounded. Rotary cultivation can reduce numbers by 60 to 70% (Boström, 1988).

Earthworms can be exposed to pesticides and other hazardous chemicals by ingesting contaminated soil or litter. Response of earthworms to pesticides is different from one species to another depending on chemicals used, rates, methods and frequency of applications (Edwards, 2004).

Activity and level of earthworm populations are often restricted by unfavourable soil moisture conditions. Irrigation of dry soils has resulted in extension of the range of lumbricid species (Barley et al. 1964; Reinecke et al. 1980) allowing some species to remain active during the hot and dry summer (Baker, 1998).

In the earthworm fauna of Romania 77 species are described (Szederjesi et al., 2019). Earlier researches focused mainly on zones from Transylvania and the inner Carpathians (Csuzdi et al., 2011). The Moldova region has not been investigated so far.

The goal of this paper was to assess the earthworm community in four agricultural crops, maize, rapeseed, barley and soybean, in the Moldova Plateau (NE of Romania) in 2020 to bring new data on earthworm fauna in our country.

MATERIAL AND METHODS

Study area. The soil sampling was performed in maize, rapeseed, barley and soybean crops in the experimental field of the Agricultural Research and Development Station Secuieni (ARDSS) in 2020. ARDSS (46°51'N/26°49'E/205.7 m) is located in Neamț County in the NE part of Romania (Figure 1).

Predominant soils are the typical cambic chernozem and the soft eumezobasic brown; the humus content varies between 2.3-3.1%; soil reaction is soft acidic (47.6%). Soils are characterized as poorly supplied with nitrogen, moderately to well supply with phosphorus and potassium. The climate type is temperate continental characterized by short springs, cool summers and harsh winters. The annual average temperature is 8.8°C. The coldest month is January (average temperature -3.8°C) and the warmest is July (average temperature 20.4°C). Annual precipitations of about 544.3 mm are unevenly distributed in the vegetation season. Data on experimental crops and agricultural techniques are described in the Table 1.

Table 1. Data on experimental areas and agricultural techniques

Agricultural techniques	Maize	Rapeseed	Barley	Soybean
Area (m²)	1764	5250	5300	5500
NPK 20:20:0 (kg/ha)	250	250	250	250
Herbicides (a.i.)	thiencarbazone-methyl tritosulfuron dicamba	dimetenamid metazaclor quinmerac	amidosulfuron iodosulfuron-metil-Na mefenpyr dietil proticonazol	pendimetalin dimetenamid imazamox bentazon

	nicosulfuron		spiroxamin tebuconazole	
Stubble-turning	x	x	-	-
Autumn plowing (30 cm) and disking	x	x	x	
Autumn plowing, ground levelling	-	-	-	x

Earthworm sampling. Earthworms were collected in September 2020. The soil was extracted using a spade and was put into a high sided tray in order to prevent earthworm escape. The extracted soil was hand-sorted for living earthworms. It was made it 15 pit soil and each soil pit had sides of 25 cm x 25 cm and 40 depth; the distance between pit soil was 10-30 cm on the crop row. The adult specimens were fixed in 70% ethanol, analysed under a stereomicroscope and identify to the species level. Juveniles are kept in the soil in the lab conditions to obtain adult stage.

RESULTS AND DISCUSSIONS

A total of 53 earthworms were collected from the soil sampled in the four agriculture crops in the experimental field of ARDSS in 2020. Of these 58.49% were adult specimens and 41.51% juveniles. Adult specimens belonged to five species *Aporrectodea caliginosa nocturna, A. caliginosa, A. rosea, Eisenia fetida* and *Dendrodrilus rubidu* (Table 2). All the five species found in our study are described in Romanian earthworm fauna.

On crops, the most earthworms (adults + juveniles) were in maize crop (39.63%) followed by rape seed with 30.18% and barley and soybean with 15.09% each.

Of the total adult earthworms, the most abundant species was *A. caliginosa nocturna* with 37.71%. This had a uniform spreading in the soil samples collected from all four crops investigated in this study. It is only species present in all crops. *A. caliginosa nocturna* is part of the endogeic ecological group which is very well known as the soil dwellers (Sherlock 2018).

E. foetida was the second most abundant species (29.03%), but this was found only in two crops, maize and rape seed.

The other three species *A. caliginosa, A. rosea* and *D. rubidu* presented a small total number of specimens, reaching 12.9% *A. caliginosa* and 9.67% *A. rosea* and *D. rubidu* each.

Table 3. Species of earthworms found in agriculture crops at ARDS Secuieni in 2020

Earthworm species	Maize	Rape seed	Barley	Soybean	Total
Aporrectodea caliginosa nocturna	5	2	2	3	12
Aporrectodea caliginosa	1	0	2	0	3
Aporrectodea rosea	2	0	2	0	4
Eisenia fetida	1	8	0	0	9
Dendrodrilus rubidus	0	3	0	0	3
Total adult individuals	9	13	6	3	31
Juveniles	12	3	2	5	22
Total (adults + juveniles)	21	16	8	8	53

The size of populations depends on a wide range of factors, including soil type, pH, moisture-holding capacity of the soil, rainfall and ambient temperatures, but the most important is the availability of organic matter. This is because interactions between organic

matter and microorganisms provide food for earthworms. The communities of earthworm species differ greatly from one site to another and from one habitat to another and there are often tend in the associations of species with soil and habitat type.

Population of earthworms in cultivated land usually do not exceed 100 specimens/m^2 (Sherlock 2018).The activity of earthworms differs greatly between seasons in temperate regions, where earthworms are active mainly in the spring and autumn. During the winter, they penetrate deeper into soil where are much more protected from the cold temperatures (Thejesh 2020). In dry summer periods, they burrow deeper in the soil and sometimes construct cells lined with mucus in which they remain in a coiled position until environmental conditions become favourable again.

CONCLUSIONS

Our data in 2020 showed presence of five species of earthworms *Aporrectodea caliginosa nocturna, A. caliginosa, A. rosea, Eisenia fetida* and *Dendrodrilus rubidu* in maize, rape seed, barley and soybean crops in the Moldova Region in North-Eastern Romania.

The most earthworms (adults + juveniles) were in maize crop followed by rape seed with and barley and soybean.

The most abundant species was *A. caliginosa nocturna* having a uniform spreading in the soil samples collected from all four crops investigated in this study.

E. foetida was the second most abundant species being found only in maize and rape seed crops.

The other three species *A. caliginosa, A. rosea* and *D. rubidu* had a small total number of specimens.

Further investigations in the next agricultural seasons become necessary to obtain more detailed data on populations of earthworms associated with agriculture crops subjected to different protective systems and pedo-climatic conditions.

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