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RESEARCH ON EARTHWORM COMMUNITY IN MAIZE CROP IN BORCEA, CĂLĂRAȘI

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Abstract

Earthworms play a variety of important roles in ecosystems. Their feeding and burrowing activities incorporate organic residues and amendments into the soil, enhancing decomposition, humus formation, nutrient cycling, and soil structural. Earthworms feed on plant debris (dead roots, leaves, grasses, manure) and soil. The purpose of this study was to assess the presence of earthworm species in maize crops in Borcea commune in Călărași Country over the years 2020-2022. The sampling consisted of 15 pits of 25 x 25 x 40 cm. Five earthworm species belonging to three genera Aporrectodea, Allolobophora, Eisenia fetida and Dendrobaena were identified. he most abundant species was Aporrectodea caliginosa. This study reports the first data on earthworm fauna for the Borcea, Călărași.

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

INTRODUCTION

Earthworms play a significant role in maize cultivation, contributing to soil health and crop productivity in several important ways: aeration and porosity, aggregation, nutrient cycling and availability (I. earthworms consume organic matter and decompose it and release nutrients in forms that plants can readily absorb (Darwin, 1881) and II. Castings are rich in nutrients like nitrogen, phosphorus, potassium an micro nutrients and the castings act as natural fertilizer that improve soil fertility), enhanced microbial activity (microbial populations stimulates by earthworms gut, play a crucial role in nutrient cycling and organic matter decomposition, also enzymes and hormones (Aira et al., 2005) that are secreted by earthworms enhance microbial activity and soil health. Another important role of earthworms: soil pH and buffering capacity (earthworms castings can help buffer soil pH (Gong et al., 2019), making it more neutral and conducive for maize growth, also their activities can reduce soli acidity), disease and pest management, organic natter incorporation, root development (Earthworms can facilitate symbiotic relationships between maize roots and beneficial mycorrhizal fungi).

Earthworms contribute to soil aggregation mainly through the production of casts, although earthworm burrows can also contribute to aggregate stability, since they are often lined with oriented clays and humic materials (Jeanson, 1964) which can form a stable structure. Most workers agree that earthworm casts contain more water-stable aggregates than the surrounding soils.

The population of an earthworm species at any one time is made up of young immature, well-grown immature (adolescent), mature, and senescent individuals, the relative proportions depending on the time of year

Large amounts of insecticides, herbicides and fungicides are applied to soil to control pests. Some of these are general biocides and may also kill earthworms. For instance, it has been shown that copper fungicides are toxic to earthworms (Edwards, 1977)

Herbicides can affect earthworm populations either directly, or indirectly by killing the vegetation on which the worms feed. Not many herbicides decrease earthworm populations directly. Pollution from neonicotinoid insecticides and heavy metals has the potential to inhibit growth as well as damage DNA and cause oxidative stress (Yan et al., 2021).

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).
Edwards et al. (1988) estimated that there were 1.6 million *L. terrestris* burrows per ha in a no-tillage maize field. These burrows are particularly important from the standpoint of water infiltration, because they open to the surface, are nearly vertical, and can as much as 2 m deep.

MATERIALS AND METHODS

Study area

The soil sampling was performed in maize crops in the experimental field from Borcea town, over the years 2020-2022. Borcea is a commune located in the Călărași County in Romania. Situated in the southeastern part of the country, Călărași County lies in the historical region of Muntenia. The commune of Borcea is positioned along the banks of the Borcea branch of the Danube River, which contributes to the area's agricultural suitability. The soil in Borcea, Călărași, Romania, is predominantly chernozem, also known as "black earth". Chernozem is a rich, fertile soil that is highly prized for agricultural activities. This type of soil is characterized by a high organic matter content and good structure, making it particularly suitable for growing crops like maize, wheat, and sunflowers. The soil in Borcea, Călărași, Romania, is predominantly chernozem, also known as "black earth". Chernozem is a rich, fertile soil that is highly prized for agricultural activities. This type of soil is characterized by a high organic matter content and good structure, making it particularly suitable for growing crops like maize, wheat, and sunflowers. Borcea receives an average annual precipitation of around 500-600 mm. Average temperature in Borcea is 23.9°C.

Earthworm sampling

Earthworms were collected in March-May and September 2020-2022. 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.

Agricultural techniques

In 2020, the following technical works were carried out: preceding crop: alfalfa; sown corn directly; irrigated soil; fertilized with 163 kg nitrogen/ha.
And phytosanitary treatments: fighting weeds with the following active substances: glyphosate 4 l/ha (herbicide); 40 g/l nicosulfuron 1 l/ha; cypermetrim 150 ml/ha.
In 2021, the following technical works were carried out: preceding crop: corn; cultivator, combiner and sower; irrigated soil; fertilized with 163 kg nitrogen/ha. And phytosanitary treatments: fighting weeds with the following active substances: glyphosate 4 l/ha (herbicide); 40 g/l nicosulfuron 1 l/ha; cypermetrim 150 ml/ha.
In 2022, the following technical works were carried out: preceding crop: corn; cultivator, combiner and sower; irrigated soil; fertilized with 163 kg nitrogen/ha. And phytosanitary treatments: fighting weeds with the following active substances: glyphosate 4 l/ha (herbicide); 40 g/l nicosulfuron 1 l/ha; cypermetrim 150 ml/ha.

RESULTS AND DISCUSSIONS

Due to the fact that the land is worked in a no-till system, we can see a very big difference in terms of earthworm populations. The month of September and April offers the best conditions for their development for adults. The lowest results are recorded in May (Table 1).

Table 1. The number of adult and juvenile Lumbricidae

Year of sampling	The number of adult and juvenile Lumbricidae			
	March	April	May	September
2020	25	30	20	27
2021	22	21	17	30
2022	28	32	27	27
Total	75	83	64	84

In the Table 2 we notice that the year 2022 was the most suitable for the development of earthworms. In 2020, 48 adult individuals were

collected and 54 juvenile earthworms, in 2021, 41 adults were collected and 49 juvenile earthworms and the last year of study in 2022, in all 4 months of the study, 51 adult individuals were collected an 63 juveniles.

Table 2. The number of adult

Year of sampling	The number of adult			
	March	April	May	September
2020	10	17	9	12
2021	11	10	7	13
2022	17	17	12	5
Total	38	44	28	30

The most abundant earthworm juveniles was recorded for all 3 years in September with a total of 54 individuals and the lowest is recorded in May with 36 individuals (Table 3).
It's possible that the influence of sowing, the herbicide as well as the seed treatment to influence earthworm populations in may because the temperature is not so high to affect earthworms.

Table 3. The number of juveniles

Year of sampling	The number of juveniles			
	March	April	May	September
2020	15	13	11	15
2021	11	11	10	17
2022	11	15	15	22
Total	37	38	36	54

In all 3 years of research, the most abundant earthworm species is *Aporrectodea caliginosa*. The most individuals met in April and the fewest in September, the populations being mostly influenced by the drought (Tables 4-7 and Figures 1-6).

Figure 1. *Aporrectodea rosea*

Figure 2. *Allolobophora chlorotica*

Figure 3. *Aporrectodea caliginosa noctura*

Figure 4. Earthworm at the surface on plant residues

Table 4. Earthworms species in 2020

Species	March	April	May	September
Aporrectodea caliginosa	3	8	3	5
Aporrectodea longa	2	3	2	2
Dendrobaena sp.	1	2	1	1
Allolobophora chlorotica	1	1	1	-
Aporrectodea caliginosa nocturna	2	2	2	3
Eisenia fetida	1	1	-	1

Table 5. Earthworms species in 2021

Species	March	April	May	September
Aporrectodea caliginosa	4	3	3	5
Aporrectodea longa	2	2	2	2
Dendrobaena sp.	1	1	-	1
Allolobophora chlorotica	1	-	-	-
Aporrectodea caliginosa nocturna	2	3	2	4
Eisenia fetida	1	1	-	1

Table 6. Earthworms species in 2022

Species	March	April	May	September
Aporrectodea caliginosa	10	7	3	2
Aporrectodea longa	3	3	2	1
Dendrobaena sp.	1	1	-	-
Allolobophora chlorotica	1	1	-	-
Aporrectodea caliginosa nocturna	2	3	2	2
Eisenia fetida	-	2	1	-

Table 7. Total Earthworms species in 2020-2022

Species	March	April	May	September	Total 2020-2022
Aporrectodea caliginosa	17	18	12	12	59
Aporrectodea longa	7	8	7	5	27
Dendrobaena sp.	3	4	1	2	10
Allolobophora chlorotica	3	2	1	0	6
Aporrectodea caliginosa nocturna	6	8	6	9	29
Eisenia fetida	2	4	1	2	9

The least common adult earthworm individuals are *Allolobophora chlorotica* and *Eisenia fetida*, these are species of earthworms that feed on the remains of vegetation on the surface of the soil and with the high temperatures in this area and the intensive drought, the populations of these species are influenced by the climatic conditions and also the influence of herbicides, chemical fertilizers and seeds treatments with neonicotinoides.

In the first year of experience, 2020, the fewest individuals were registered and in 2022, the most individuals was colected. The influence of no-till technology has a beneficial influence on the soil structure as well as the earthworm populations.

Figure 5. Juvenile earthworm

Figure 6. *Aporrectodea longa*

CONCLUSIONS

Our data from 2020-2022 showed presence of six species of earthworms *Aporrectodea longa, Aporrectodea caliginosa, Aporrectodea caliginosa nocturna, Allolobophora chlorotica, Dendrobaena* sp.*, Eisenia fetida.*

The most earthworms (adults + juveniles) were found in maize crop especially in the 2022 in April and September. The most abundant species was *Aporrectodea caliginosa* with a total of 59 adult individuals found in the 3 years of study, in March 2022 it was found 10 individuals.

The next species with the most adults is *Aporrectodea caliginosa nocturna* with 29 adult individuals and the species with the fewest specimens being *Allolobophora chlorotica* with 6 adult individuals. In this three years of study, it appears that the April month is the most favorable for the development and activity of earthworms.

Under no-till conditions the earthworm populations are much more abundant than in those where plowing is applied. Analyzing the 3 years of studies, we can see the difference. From year to year, more individuals were collected due to the humidity conditions in the soil, the fact that there are more plant residues as food for earthworms and last but not least, let's not forget that the exclusion of plowing offers the development of earthworm populations.

In March, April and September on the surface of the soil are many plant residues and also the temperature of the soil and the humidity are suitable for earthworm populations.

And another aspect it is that has been scientifically proven that plowing reduces up to 70% of earthworm populations.

For alive and healthy soil, the technique of cultivating maize in no-till is beneficial. It can be seen from the data that every year more and more adult and juvenile individuals have been found that have a positive impact on soil fertility and structure.

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