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RESEARCH ON EARTHWORM COMMUNITY IN MAIZE CROP IN DOBROGEA PLATEAU

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Abstract

Earthworms play an important role in soil formation contributing to the composition and functioning of its ecosystem. By their activity in the soil, earthworms offer many benefits: increased nutrient availability, better drainage, and a more stable soil structure, all of which help improve farm productivity. The purpose of this study was to assess the presence of earthworm species in maize crops in Dobrogea Plateau 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 and Proctodrilus were identified. he most abundant species was Aporrectodea caliginosa nocturna and Aporrectodea caliginosa. This study reports the first data on earthworm fauna for the Dobrogea Plateau.

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

INTRODUCTION

Earthworm has caught imagination of philosophers like Pascal and Thoreau. Yet its role in the nutrition of agricultural fields has attracted attention of researchers worldwide only in recent decades (Adhikary, 2012)

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. Excessive use of chemical pesticides and pesticide fertilization and loss determine negative effects on the environment, soil and food pollution with waste, degradation of soil quality (Ju et al., 2009) and agricultural biodiversity (Minuto et al., 2006; Gill and Garg, 2014). According to Fred (1991), agriculture has had both positive and negative effects, and the use of synthetic fertilizers leads to the loss of the soil's natural nutrients when used on its surface. 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 (Amuza et al., 2020)

Earthworm activity makes a significant contribution to soil aeration (Kretzschma, 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).

MATERIALS AND METHODS

Study area. The soil sampling was performed in maize crops in the experimental field from Beidaud town, over the years 2020-2022. The town of Beidaud is located in the south-estern part of Tulcea (N 44°42′35, 9″, E 28°35′42,6″). The soil is argilloiluvial chernozem. The climate of the Beidaud area is characteristic of the semi-arid steppe region, with two types of microclimate, a silvo-steppe near the forest and a dry steppe. The climate is temperate, with a pronounced continental character, manifested by hot summers, cold winters, often marked by blizzards and low precipitation. Average annual precipitation totals between 359 mm. The average temperature being 23°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. The field was treated with 42.9% nicosulfuron + 10.7% rimsulfuron (herbicid) 250 ml/ha, lambda-cihalothrin 5% (insecticid) 250 ml/ha, piraclostrobin 200 g/l (fungicid) 1 l/ha, the soil was fertilized with 180 kg nitrogen/ha, soil work: weeding, autumn plowing at a depth of 30 cm, discussed. In 2020 the maize was irrigated and in 2021-2022 maize was grown without irrigation.

RESULTS AND DISCUSSIONS

According to Table 1, we observe a much higher density of both adults and juveniles in 2020 because the land was irrigated, and the earthworms had optimal development conditions compared to the other years when irrigation was abandoned. In 2020, a total of 57 individuals of adult and juvenile Lumbricidae were collected, in 2021, 30 individuals were collected and identified, and in the 2022 study year, 15 were collected.

Table 1. The number of adult and juvenile Lumbricidae

Year of sampling	The number of adult and juvenile Lumbricidae			
	March	April	May	September
2020	15	20	12	10
2021	10	12	3	5
2022	3	5	5	2
Total	28	37	21	17

According to Table 1, the populations of earthworms are much more numerous in the month of April, because the soil temperature and humidity are favorable for them.

Table 2. The number of adult

Year of sampling	The number of adult			
	March	April	May	September
2020	5	8	5	3
2021	3	5	1	2
2022	1	2	1	0
Total	9	15	7	5

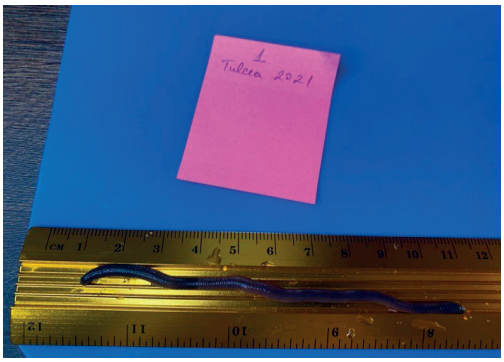
In the Table 2 we notice that the year 2022 was the most suitable for the development of earthworms, the irrigation system having a great impact on their development. In 2020, 21 adult individuals were collected, in 2021, 11 adults were collected and in 2022, in all 4 months of the study, only 4 adult individuals were collected.

Table 3. The number of juveniles

Year of sampling	The number of juveniles			
	March	April	May	September
2020	10	12	8	7
2021	7	7	2	3
2022	2	3	4	2
Total	19	22	14	12

In Tables 4, 5 and 6 we observe the fluctuations of earthworm populations from one month to another. In this area we identified 6 species of Lumbricidae: *Aporrectodea trapezoids, Aporrectodea longa, Aporrectodea smaragdina, Aporrectodea caliginosa, Aporrectodea caliginosa nocturna, Allolobophora chlorotica* (Picture 3).

Were found six different species, only one species is part of the anecic group, reespectively *Aporrectodea caliginosa nocturna* (Picture1), the other five species are part of the edogeic ecological group. In all three years, the *Aporrectodea caliginosa* (Picture 2) species resists the environmental conditions best, finding a total of 16 individuals. Autumn plowing destroys in very large proportions the populations of earthworms, in general the epigeic ones that stay on the surface of the soil and that feed mostly on organic matter.



Picture 1. *Aporrectodea smaragdina*

Table 4. Lumbricidae species in 2020

Species	March	April	May	September
Aporrectodea trapezoides	3	3	-	-
Aporrectodea longa	2	-	2	-
Aporrectodea smaragdina	-	3	-	-
Allolobophora chlorotica	-	2	-	-
Aporrectodea caliginosa nocturna	-	-	-	2
Aporrectodea caliginosa			3	1

Table 5. Lumbricidae species in 2021

Species	March	April	May	September
Aporrectodea trapezoides	-	2	-	-
Aporrectodea longa	-	-	-	-
Aporrectodea smaragdina	-	-	-	-
Allolobophora chlorotica	-	-	-	-
Aporrectodea caliginosa nocturna	-	1	-	-
Aporrectodea caliginosa	3	2	1	2

Table 6. Lumbricidae species in 2022

Species	March	April	May	September
Aporrectodea trapezoides	-	2	-	-
Aporrectodea longa	-	-	-	-
Aporrectodea smaragdina	-	-	-	-
Allolobophora chlorotica	-	-	-	-
Aporrectodea caliginosa nocturna	1	-	-	-
Aporrectodea caliginosa	0	2	1	-

Table 7. Average monthly minimum temperatures

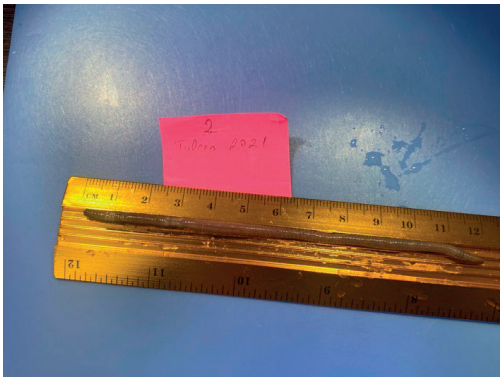
Average monthly minimum temperatures												
Year	January	February	March	April	May	June	July	August	September	October	November	December
2020	-2.0	0.3	3.2	2.7	9.6	14.7	16.7	16.3	13	10.7	2.5	1.7
2021	0.9	-1.5	0.1	4.2	10.4	15.3	17.3	16.8	10.6	5.8	3.8	0.2
2022	-2.4	-1	-2	5.1	9.8	15.3	17.2	19	12	6.3	3.7	0.2

Table 8. Average monthly maximum temperatures

Average monthly maximum temperatures												
Year	January	February	March	April	May	June	July	August	September	October	November	December
2020	6.6	11.2	15.1	18.9	22.4	28.6	31.1	30.1	27.4	21.8	10.4	7
2021	6.4	7.2	10.1	15.2	22.7	26.1	31.3	30.6	23.7	16.3	13.4	7.5
2022	6.2	10.6	9.4	18.3	24.5	28.6	31.5	32	25.2	20.6	13.4	8.3

Table 9. Average monthly precipitation

Average monthly precipitation												
Year	January	February	March	April	May	June	July	August	September	October	November	December
2020	0.03	6.02	0.02	0.08	0.94	0.39	0.48	0	0.51	0.72	1	1
2021	1.85	0.2	0.38	0.38	0.25	1.97	0.41	0.41	0.35	0.92	0.09	1.15
2022	0.24	0.25	0.19	0.41	0.98	1.47	0.35	0.20	0.46	0.29	0.58	0.59



Picture 2. *Aporrectodea caliginosa*

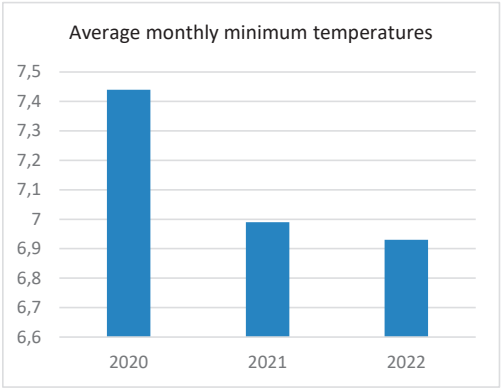


Figure 1. Average monthly minimum temperatures

In 2020 the average of the minimum annual temperatures according to the Figure 1, are much higher (the average 7.44) compared to the two years, respectively 2021 (the average 6.99) and 2022 (the average 6.93) where much lower temperatures were recorded, favoring the development of the earthworm populations compared to the last two years of study, as they are very sensitive to low temperatures.

In 2021 and 2022, the average minimum temperatures are similar, respectively the average of 83.9 for the year 2021 and the average of 83.2.

According to the Figure 2, the average maximum temperatures are recorded in 2022, the average being 18.5 in comparison with the other two years of study, respectively the average of 2021 is 17.54 and the average of 2020 being 18.51.

Picture 3. *Allolobophora chlorotica*

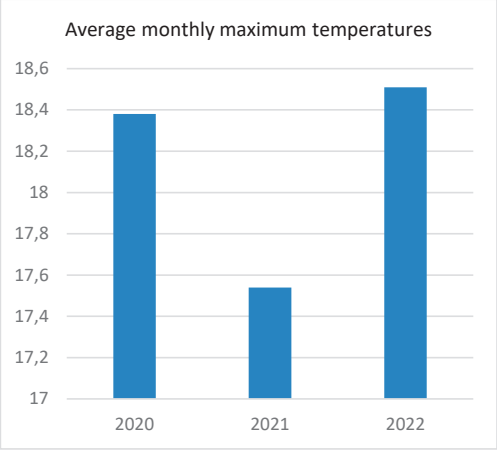


Figure 2. Average monthly minimum temperatures

The highest precipitation average, according to the Figure 3 was recorded in 2021, being 0.69, compared to the two years, 2020 recording the lowest precipitation average of 0.47.

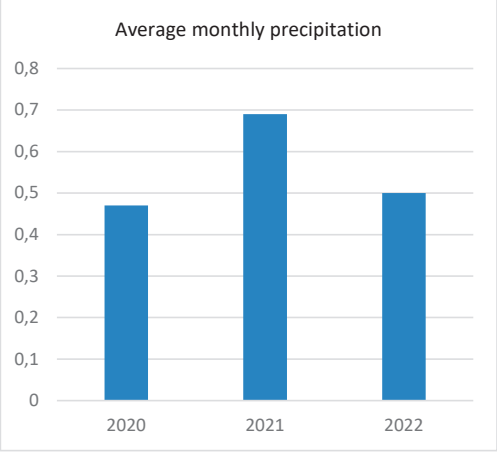


Figure 3. Average monthly precipitation

CONCLUSIONS

Our data from 2020-2022 showed presence of six species of earthworms *Aporrectodea trapezoids, Aporrectodea longa, Aporrectodea smaragdina, Aporrectodea caliginosa, Aporrectodea caliginosa nocturna, Allolobophora chlorotica.*

The most earthworms (adults + juveniles) were found in maize crop especially in the 2020 in April. The impact of the irrigation system on earthworm populations is quite large, which is also evident from tables 7, 8, 9, in 2020 although the average rainfall was the lowest with soil moisture and a milder winter compared to other years, earthworm populations could develop much better without being stressed by the level of soil moisture. The most abundant species was *Aporrectodea caliginosa* with a total of 15 adult individuals found in the 3 years of study and just in 2021 it was found 8 idividuals. The next species with the most adults is *Aporrectodea trapezoids* with 10 adult individuals and the species with the fewest specimens being *Allolobophora chlorotica* with 2 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.

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