CORRELATIONS BETWEEN SEVERAL CHEMICAL PARAMETERS OF SOIL AND EARTHWORMS' DENSITY DEPENDING ON PLANT CULTURE AND ORGANIC-MINERAL FERTILIZATION

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Abstract: *Researches have been carried out on the land of Didactic Station of UASVMB Timişoara, on a cambic chernozem, low gleyed. Identification of the pedological conditions and the morphological description of soil profile, as well as soil identification by type, respectively by subtype, have been made according to Romanian System of Soil Taxonomy (SRTS, 2003). Soil sampling was made by genetic horizons in natural arrangement and disturbed arrangement. Two types of organic-mineral fertilizers with granules coated with humic-potassic acids have been tested, noted L-200-HUM and SH-120. The researches have been carried out in two plan cultures, maize (Zea mays L.) and sun-flower (Helianthus annuus L.). On the soil of these crops the organic-mineral fertilizers have been applied in dose of 83 kg active substance (N)/ha. Earthworms' extraction from soil has been realised using formaldehyde method according to ISO 23611-1/2006. There was found a higher earthworm number in maize culture than in sun-flower culture. In fertilization with L-200-Hum was found that earthworm number was considerably higher than in fertilization with SH-120. In sun-flower culture the tendency is similar, under action of fertilizer L-200-Hum was recorded a larger number of earthworms as compared to fertilization with SH-120. Generally, the values recorded for earthworm weight are related to values describing earthworm density, with several exceptions depending on species size, as well as different weights of individuals from different development stages, because juveniles weigh less than adults. The achieved results have been correlated with values of several chemical indices of soil: pH and content of total organic carbon (TOC).*

Key words**:** *earthworms, chemical, soil, plant, fertilization, pH, total organic carbon*

INTRODUCTION

Researches concerning the connections between various physical and chemical parameters of soil and earthworms have been previously performed by numerous researchers in various experimental conditions and experimental devices [1-8].

Within research was pursued to establish the way how earthworm density and weight were affected by two types of organic-mineral fertilizers with granules coated with humic-potassic acids, noted L-200-HUM and SH-120, which necessitate to pass the test aiming the impact on pedofauna (earthworms) to be used in agriculture.

MATERIAL AND METHODS

The researches have been carried out on the land of Didactic and Experimental Station of the University of Agricultural Sciences and Veterinary Medicine of Banat (UASVMB), from Timisoara, Romania. The researches have been carried out on the land of Didactic Station of UASVMB Timişoara. The research area is placed in the low plain of subsidence and divagation of Timiş River.

The researches have been performed on a cambic chernozem, low gleyed, medium loam clayey/medium loam clayey. Identification of the pedological conditions and the

morphological description of soil profile, as well as soil identification by type, respectively by subtype, have been made according to Romanian System of Soil Taxonomy (SRTS, 2003) (table 1).

Table 1

Chemical, physical and hydrophysical properties of chernozem from Didactic Station of UASVMB Timişoara

Pedogenetic horizon	**Ap**	**Atp**	**Am**	**AB**	**BC**	**Cca g_1**	**Cca g_1**	**Cca g_2**
Depth of the pedogenetic horizon (cm)	0-20	20-35	35-50	50-65	65-85	85-110	110-130	130-200
pH in water (pH unities)	6,00	6,60	6,70	6,90	7,75	8,10	8,15	8,25
$CaC0_3$ (%)	-	-	-	-	0,60	15,50	17,70	10,80
Total organic carbon (%)	2,97	2,79	2,42	2,23	1,73	0,93	-	-
N total (%)	2,58	2,48	2,20	2,11	1,73	0,93	-	-
P_{AL} ppm	35,0	7,2	6,7	-	-	-	-	-
K_{AL} ppm	322,0	262,3	259,8	-	-	-	-	-
Base saturation (% of total)	87,0	89,0	91,2	94,9	100	100	100	100
Capacity of cation exchange (meq · 100 g^{-1} soil)	29,0	30,3	29,4	28,9	-	-	-	-
H^+ exchangeable (meq · 100 g^{-1} soil)	3,64	3,32	2,58	1,47	-	-	-	-
Coarse sand (2.0-0.2 mm) (%)	0,2	0,6	0,2	0,6	0,6	0,5	0,3	1,1
Fine sand (0.2-0.02mm) (%)	28,2	27,0	29,6	29,6	30,7	32,2	32,5	20,1
Dust (0.02-0.002 mm) (%)	27,5	29,3	24,8	24,7	23,4	26,3	28,1	33,9
Clay (<0.002 mm) (%)	44,1	43,1	45,4	45,0	45,3	41,0	39,0	44,9
Physical clay (<0.01 mm) (%)	55,2	56,4	59,3	55,2	59,4	55,6	55,9	63,9
Texture class	TT	TT	TT	TT	TT	TT	TT	TP
Density ($g \cdot cm^{-3}$)	2,51	2,51	2,62	2,57	-	-	-	-
Bulk density ($g \cdot cm^{-3}$)	1,44	1,54	1,36	1,52	-	-	-	-
Total porosity (%)	41,04	38,65	48,09	40,86	-	-	-	-
Blight coefficient (%)	13,35	13,65	13,20	13,20	-	-	-	-
Water field capacity (%)	28,10	28,18	29,06	26,06		-	-	-
Useful water capacity (%)	14,75	14,53	15,86	14086	-	-	-	-

Two types of organic-mineral fertilizers have been tested: L-200-Hum and SH-120. Chemical composition and physical properties of these fertilizers are listed in table 2.

Table 2

Chemical composition and physical properties of the organic-mineral fertilizers tested on earthworms

No.	Chemical compositions	Organic-mineral fertilizer	
		L-200-Hum	SH-120
1	Humic acids	29.9%	26.4%
2	Nitrogen	23.49%	10.47%
3	P_2O_5	-	16.50%
4	K_2O	0.255%	0.307%
Chemical and physical properties			
5	Capacity of cation exchange	96.3 me/100g	100.3 me/100g
6	pH in water (pH unities) 1:2.5	7.3	7.0
7	Bulk density	0.823 g/cm^3	0.852g/cm^3
8	Granularity (1-5 mm)	89.9%	93.5%

The researches have been carried out in two plan cultures, maize *(Zea mays* L.*)* and sun-flower *(Helianthus annuus* L.*)*. Earthworms' extraction from soil has been realised using formaldehyde method according to ISO 23611-1/2006. The achieved results have been correlated with values of several chemical indices of soil: pH and content of total organic carbon (TOC).

RESULTS AND DISCUSSIONS

The organic-mineral fertilizers have been applied in dose of 83 kg active substance (N)/ha. In table 3 are presented the mean values regarding the parameters earthworm number and earthworm weight, aiming to distinguish the differences appeared between two crops and two types of fertilization.

Table 3

Mean values regarding the parameters earthworm number and earthworm weight in maize and sun-flower in organic-mineral fertilization

Culture plant/ Experimental variant		Earthworm number (individuals/m^2)	Earthworm weight (g/m^2)	pH (pH units)	TOC (%)
Maize	Control	28,33±3,51	8,32±0,15	6,51±2,88	2,08±7,71
	L-200-Hum	39,20±1,64	16,22±0,91	6,80±3,34	2,52±4,33
	SH-120	28,00±3,31	10,75±0,61	6,75±2,91	2,18±5,12
Sun-flower	Control	21,33±3,51	5,24±0,98	6,48±0,10	2,14±6,00
	L-200-Hum	19,40±2,07	5,68±0,34	6,60±7,71	2,50±2,95
	SH-120	11,20±1,92	3,35±0,29	6,34±3,74	2,60±4,39

There was found that in maize culture earthworm number was higher than in sun-flower culture.

In fertilization with L-200-Hum was found that earthworm number was considerably higher than in fertilization with SH-120. Thus, in maize culture were recorded 40.00% more earthworms under action of L-200-Hum comparatively with control, and 38.36% more earthworms as compared to fertilization with SH-120.

The same tendency of evolution was also found for the parameter earthworm weight.

In sun-flower culture the tendency is similar, under action of fertilizer L-200-Hum was recorded a larger number of earthworms as compared to fertilization with SH-120, 73.21% larger. As compared with control, there was found in sun-flower culture in both type of fertilization that earthworm number decreased, which sustain the results achieved by laboratory test, but this decrease is not under a critical level, which allows earthworms to restore their populations in time. Thus, earthworm number found in variants cultivated with sun-flower and fertilized with L-200-Hum was 9.05% lower as compared with control and 42.27% lower in fertilization with SH-120 related to control.

Results concerning earthworm density and weight have been correlated to values of pH and content of total organic carbon (TOC) using the software SPPS 8.0 for calculating correlation coefficient Kendall and Spearman (table 4).

Table 4

Correlations between earthworm number and chemical parameters of soil (*P<0.05, **P<0.01)

	Treatment type	Correlation coefficients		pH	TOC
Maize	L-200-Hum	Kendall's correlation coefficient	Earthworm number	-0,943*	0,943*
		Signification (1-tailed)		0,032	0,032
		Spearman's correlation coefficient	Earthworm number	-0,973**	0,973**
		Signification (1-tailed)		0,005	0,005
	SH-120	Kendall's correlation coefficient	Earthworm number	-0,889*	0,889*
		Signification (1-tailed)		0,037	0,037
		Spearman's correlation coefficient	Earthworm number	-0,947*	0,947*
		Signification (1-tailed)		0,014	0,014
Sun-flower	L-200-Hum	Kendall's correlation coefficient	Earthworm number	- 0,800*	0,949*
		Signification (1-tailed)		0,05	0,023
		Spearman's correlation coefficient	Earthworm number	-0,900*	0,975**
		Signification (1-tailed)		0,037	0,005

	SH-120	Kendall's correlation coefficient	Earthworm number	-0,894*	0,949*
		Signification (1-tailed)		0,037	0,023
		Spearman's correlation coefficient	Earthworm number	-0,949*	0,975**
		Signification (1-tailed)		0,014	0,005

There were found negative correlations between values describing earthworm density on meter square and values of pH and respectively positive correlations between parameters earthworm density and content of TOC of soil, findings which have been also reached in several previously researches.

CONCLUSIONS

Earthworm number was higher in maize culture than in sun-flower.

In fertilization with L-200-Hum was found that earthworm number was considerably higher than in fertilization with SH-120 in both plant cultures.

There were found negative correlations between parameters earthworm density and pH and respectively positive correlations between parameters earthworm density and content of TOC of soil.

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