

THE CONTENT OF TRACE ELEMENTS IN SOILS AND PLANTS NEAR THE HIGHWAYS OF THE REPUBLIC OF MOLDOVA

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Abstract

The results of determination of total and mobile forms of Mn, Cu, Zn, Pb in soils and plants near the traffic routes has been present. Research has highlighted the influence of emissions on the accumulation degree in the soils (0-10 cm) and plants of Mn, Cu, Zn, Pb in south direction in the interval of 5-15 m and 50-100 m distance from the road. Forest in the neighborhood serves as a barrier to accumulation of trace elements, depositing them in high concentrations in the litter. Accumulation of trace elements is more intense in vegetables cultivated near the highways; with high concentrations in leaves (cabbage, tomatoes). The cereals straw accumulate trace elements below the maximum allowed.

Introduction

Soil pollution is the actions that can cause disruption of normal operation of the soil as a medium of life in various natural and anthropogenic ecosystems, causing harmful occurrence in soil characteristics that affect the bio-capacity of the soil. Most important source of environmental and soil pollution near the road is the exhaust of vehicles. Concentrations of trace elements in soil depend on soil type, topography, vegetation cover and wind direction [1, 2].

Experimental part

As research object served the Chernozem ordinary surrounding the traffic path Chisinau-Tiraspol (km 31) with heavy traffic movement. Soil samples were taken on both sides of the road axis by a distance in a southerly direction 250 m to 600 m to the north, the depths of 0-10, 10-20, 20-30, 30-40 cm, beyond these limits there is the forest. The spaces between the road and the forest are planted with tomatoes (south) and winter wheat (north). This is a typical landscape of car lines, which requires a strict control of both the soil and the plants that can accumulate excessive amounts of pollutants.

Determination of the total content of Mn, Cu, Zn and Pb in soil samples made by the classical method of dissolution with hydrofluoric acid in combination with sulfuric acid. The content of the mobile forms was determined in a solution of $\text{CH}_3\text{COONH}_4$ (pH 4.8). Determination was performed by atomic absorption spectrophotometer, Carl Zeiss-Jena, AAS-1 type.

Results and Discussions

The total content

The Pb is a minor component of soil and vegetation, but toxic to the humans and animals. It does not have an action on the plant nutrient. Due to the low insolubility the Pb is less mobile in the soil. Translocation in the plants in generally is low and only in the roots. In the agricultural soils non polluted the content of Pb in average is 20 mg/kg, but it can reach even higher in soils near highways (fig.1). The source of contamination is the exhaust of vehicles. Higher gasoline containing as additives tetraethyl, which contains about 0.5 g Pb/liter.

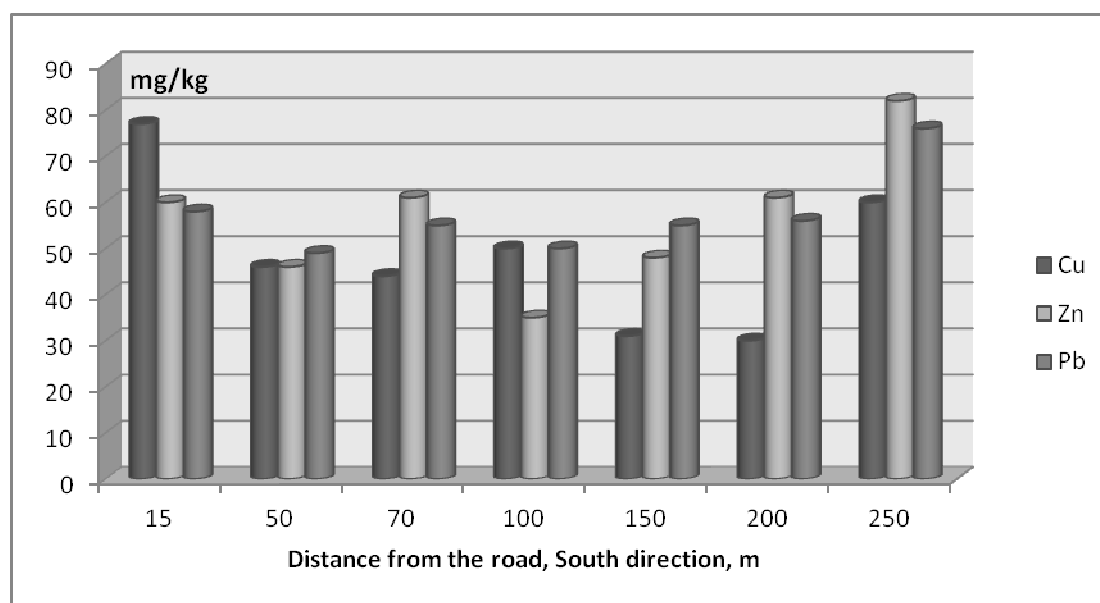


Fig.1 The content Pb, Zn, Cu in the soil, South direction

Analyzing the content of Pb in soil samples may be a difference between the two directions investigated. In the southern part of the Pb concentration is

higher than in the North. These values correlate with greater frequency and dominance wind SW to NE direction. However, a question may be space expansion drafts lowest (3 times) in the south than in the north. So here is create a "niche" artificial microclimate distribution specific action on smoke particles, microelements. The highest concentration of Pb was found at a distance of 15 m on both sides of the road (57.7 and 38.6 mg/kg). The maximum concentration (76.2 and 39.0 mg/kg) was accumulated in the vicinity of the forest, in the soil layer 0-10 cm (Table 1).

The Cu and Zn are fairly well studied elements in the soil, the average concentration being 20 and 50 mg/kg. The highest value of the content of copper was determined in the samples of soil of 15 m (77.2 mg/kg) and 250 m (60.4 mg/kg) in South, 500-600 m (40 mg/kg) in the North direction. The highest concentration of Zn was near the road, 5 m north - 155 mg/kg (Table 1).

Table1

The total content of trace elements in ordinary chernozem, mg / kg

South Direction				Distance, m	Depth, cm	Distance, m	North Direction			
Mn	Cu	Zn	Pb				Mn	Cu	Zn	Pb
1456	77.2	60.3	57.7	15	0-10	5	925	35.5	155.0	33.4
870	71.0	56.0	50.1		10-20		813	31.0	154.0	32.4
760	68.1	46.0	56.2		20-30		891	35.0	93.0	39.4
799	48.5	36.0	32.0		30-40		851	34.0	71.0	34.1
2405	45.7	46.0	49.0	50	0-10	15	927	32.7	88.9	38.6
891	39.8	41.0	42.0		10-20		891	33.1	79.4	39.0
794	22.4	40.0	43.0		20-30		813	36.3	70.8	40.6
724	25.1	36.0	38.0		30-40		851	35.5	58.9	34.7
1122	44.7	61.0	54.6	70	0-10	50	931	28.2	70.8	35.5
851	57.5	68.0	47.8		10-20		861	30.9	53.7	28.8
794	42.7	70.0	56.2		20-30		794	39.8	58.9	29.5
790	26.3	62.3	32.0		30-40		794	35.5	53.7	29.9
1050	49.6	34.5	50.1	100	0-10	150	891	33.9	75.9	25.5
962	41.5	36.4	47.9		10-20		759	35.5	39.3	27.5
900	37.0	36.4	25.1		20-30		851	39.5	57.5	33.9
850	33.1	48.4	28.2		30-40		871	38.0	58.9	32.4
1000	30.9	48.4	55.2	150	0-10	300	794	36.3	66.1	27.5
912	40.7	49.5	64.7		10-20		692	33.9	79.4	36.3
955	38.0	61.5	70.8		20-30		851	46.8	75.9	33.9
708	26.9	43.1	35.5		30-40		977	38.0	66.1	30.2
1479	30.0	60.6	56.2	200	0-10	500	890	40.0	70.8	35.5
1698	40.0	72.4	44.7		10-20		813	31.0	53.7	28.8
912	35.0	61.5	70.8		20-30		890	31.0	58.9	29.5
955	26.0	39.6	35.5		30-40		850	31.0	58.9	29.5
1995	60.4	82.4	76.2	250 near the forest	0-10	600 near the forest	1020	41.0	93.3	39.0
1585	54.0	86.5	59.8		10-20		980	38.0	75.0	33.9
1891	29.0	66.0	60.3		20-30		891	32.0	58.8	30.2
1698	22.0	49.0	28.2		30-40		891	32.0	58.8	28.8

Increased values of Mn (2405 mg/kg) were detected at a distance of 70 m south, exceeds the average content (850 mg/kg) of 2.8 times. In the south, Mn concentrations exceed normal values; while in the north will be reduced to them.

Regarding soils located a either side of the motorway (north and south), the total content of trace amounts are generally the same size, but decreasing with distance and accumulate near the forest litter.

The content of mobile forms

Soil solution contains the small amounts of trace elements in the ionic form or organic complexes. Soluble forms directly accessible to the plant are in chemical equilibrium with the other fractions in the soil and in particular with exchangeable and adsorption forms from fine-ground, amounted to 10% of the total. The average content in soil: Mn - 50, Cu - 0.7, Zn - 1.5 mg/kg.

The values obtained show the accumulation in 0-10 cm of soil layer, values exceeding normal content in soils unpolluted. It finds the highest values of Zn content in the north at a distance of 5 m (17.5 mg/kg) and 150 m (12.3 mg/kg) from the road. In the south accumulation is detected for Mn and Zn in litter (Table 2).

Table 2

The content of mobile forms of trace elements in ordinary chernozem, mg/kg

South			Distance, m	Depth, cm	Distance, m	North		
Mn	Cu	Zn				Mn	Cu	Zn
0	1	2	3	4	5	6	7	8
50	0.9	2.8	15	0-10	5	110	0.9	17.5
35	0.7	2.4		10-20		70	0.7	14.0
27	0.7	1.8		20-30		65	0.7	4.2
18	0.4	1.8		30-40		51	0.7	2.8
100	0.8	1.8	50	0-10	15	80	0.9	3.5
60	0.7	1.8		10-20		26	0.7	1.8
40	0.7	1.8		20-30		18	0.7	1.8
30	0.7	1.4		30-40		23	0.7	1.8
70	0.9	4.3	70	0-10	50	88	0.7	3.5
65	0.9	2.4		10-20		28	0.7	1.8
46	0.7	1.8		20-30		23	0.7	1.8
30	0.7	1.4		30-40		23	0.7	1.8
60	0.9	1.8	100	0-10	150	100	3.2	12.3
23	0.9	1.8		10-20		48	0.9	1.8
16	0.9	1.8		20-30		38	0.9	1.8
16	0.9	1.8		30-40		36	0.9	1.8
55	0.9	1.8	150	0-10	300	46	0.9	8.8
40	0.9	1.8		10-20		38	0.9	3.5
20	0.7	1.8		20-30		33	0.9	1.8
12	0.7	1.8		30-40		28	0.9	1.8

0	1	2	3	4	5	6	7	8
68	0.7	1.8	200	0-10	500	50	0.9	3.4
20	0.7	1.8		10-20		30	0.9	1.4
16	0.7	1.8		20-30		28	0.9	1.4
15	0.7	1.8		30-40		39	0.9	1.4
95	0.9	8.8	250	0-10	600	75	0.9	7.8
58	0.9	5.3	near the	10-20	near the	61	0.9	1.8
45	0.7	1.8	forest	20-30	forest	55	0.9	1.4
35	0.7	1.8		30-40		61	0.9	1.4

The content of mobile forms of Mn, Zn, Cu exceeds their average on the distance of 200 m south and 500 m north only in the 0-10 cm soil layer. High intensity of circulation, and lack of airflow favoring accumulation in soil of trace elements, they accumulate in the forest litter, but without exceeding the allowable standards.

Information on the total and available forms of micronutrients in soil completes the necessary data for soil studies, regarding the level of soil fertility. They can also be highlighting the additional indicators of pedogenetic processes. At the same time, the content of micronutrients in the soil of interest in environmental studies for identification of areas affected by a heavy metal pollution arising from human activities. Since the chemical composition of the soil is constantly changing both through pedogenetic processes slow and fast, with direct implications on ecosystems and natural micro ecosystems, leading to irreversible changes, it is necessary to establish a permanent system of soil quality monitoring.

Mn, Cu, Zn in plants

The plant samples were collected from the same points as the sample of soil. The results are shown in Table 3.

Table 3

The total content of trace elements in plants, mg / kg

Distance, m	Sud			Plants - tomatoes	Distance, m	Plants	Nord		
	Mn	Cu	Zn				Mn	Cu	Zn
0	1	2	3	4	5	6	7	8	9
15	150	210	59	leaves	5	walnut	145	7,0	24
	63	170	89	strains		leaves			
	8	15	50	fruits					
50	145	170	48	leaves	15	stubble	45	4,5	133
	65	75	65	strains		(straw)			
	13	16	36	fruits					
70	132	51	40	leaves	50	„,-“	33	2,5	85
	38	11	36	strains					
	20	12	33	fruits					
100	200	60	53	leaves	150	„	20	1,7	53
	85	23	71	strains					
	8	8	30	fruits					

0	1	2	3	4	5	6	7	8	9
150	163 70 8	28 11 8	36 48 38	leaves strains fruits	300	„	22	1,7	18
200	150 45 -	21 7 -	41 35 -	leaves strains fruits-lack	500	„	50	2,0	18
250 near the forest	438	16	57	forest foliage	600 near the forest	Forest foliage	57	3,5	26

The northern side of the road (600 m) was sown with winter wheat. At the moment of investigations wheat was tight, so was analyzed stubble (straw). In the south, the area of 250 m of the road and the forest was planted with tomatoes, which were still ripe at harvest samples. Tomatoes had normal development until the distance of 150 m, at a distance of 200 m plants were small, very poorly developed, tomatoes (fruit) were missing.

A large accumulation of elements are found in the leaves of tomato and walnut trees near the road, and the lowest in tomato. Thus, the data obtained, it is found that the variations in total Cu content in the plant correspond to smaller changes with the ground. This shows that plants taken from soil small amounts of Cu, and its presence in large amounts in crop plants is due to penetration by spraying the plants with preparations containing CuSO₄. It was found that there was a significant correlation (r=0.83) between the Zn in the soil and its presence in the plant. All correlations between the content of Zn, Pb in soil and concentrations of these elements in crops require intense action to stop charging the soil with these items.

Conclusions The researches revealed emissions influence the degree of accumulation in soil (0-10 cm) and plant of Mn, Cu, Zn, Pb in a southerly direction on the range of 5-15 m and 50-100 m away from the road. Accumulation of trace elements is more intense in tomato leaves, stems and tomatoes.

It is recommended that the distance of 100 m from the road (on both sides) to be grown only industrial crops, excluding the growing of fruit, vegetables and fodder plants. In these areas it is necessary to apply phytotechnical measures, soil pH should be maintained at values above 6.2-7.0. On these soils will be administered increased amounts of organic fertilizers. Do not allow cattle grazing on the brink of the roadside.

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