AGROCHEMICAL MODIFICATIONS IN ZLATNA SOILS UNDER HEAVY METAL POLLUTION

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ABSTRACT

The paper presents a synthesis of the agrochemical modifications determined by heavy metal pollution in the Zlatna area- Alba county.

These modifications present the contamination effects of soil plant contamination with heavy metals (Pb, Cd, Cu, Zn), on the background of acidification-dealkalinization processes determined in the soils through excessive industrial emissions with sulfur oxides and sulphides of metals. At the end of the polluting activity (years 1998-2001) soil degradation through heavy metal pollution involved chemical and physical phenomena that exerted their influence on soils for several decades, diminishing the productivity of agroecosystems and even removing them from the agricultural circuit, for their recovery and ecologic reconstruction.

INTRODUCTION

The industrial activity in Zlatna for several decades during the past century and partially the beginning of this millennium has determined an increased and even excessive level of pollution for agroecosystems in the area, residing in the contamination of soils-vegetation and waters with heavy metals (Pb, Cd, Cu, Zn).

This overexertion of the soil-plant system with heavy metals occurred at the same time as other soil degradation phenomena- acidification, dealkalinization, colloid destruction, etc- caused by industrial emissions, contaminated with sulfur oxides and metal suphides.

The hereby paper presents a synthesis of the main agrochemical modifications in the polluted soils of the Zlatna area.

MATERIAL AND METHOD

For the present paper, soil analyses in OSPA Alba and USAMV Cluj-Napoca (the department of agrochemistry) were interpreted relying on INCDPAPM Bucharest.

RESULTS AND DISCUSSIONS

Relevant agrochemical modifications in the soils emphasize its physico-chemical degradation and high and excessive heavy metal contamination in the soil-plant system.

a) <u>Acidification and dealkalinization of heavy metal-polluted soils:</u>

Industrial emissions that are excessively contaminated with sulphur oxides and heavy metal oxides (Pb, Cd, Cu, Zn) lead to an excessive acidification of the soil, with a permanent, multiannual character, occurring at the same time as dealkalinization (table 1)

Table 1

Soil Agrochemical indicator	Pedologic horizon/depth, cm			
Typical luvisol	A_{tel} 0-8	A_o 10-20	E_l 30-65	B_{tw} 80-90
pHH_2O V%	3.8 21	4.4 29	4.7 40	4.9 60
Typical luvisol	A_p	A_o	E_l	B_{tw}
pHH_2O V%	4.2 38	4.8 40	4.9 50	5.2 70

The phenomenon of acidification in the above mentioned situations, confirms previous data obtained in the agrochemical study of soils in Zlatna and other areas (1), (2), (3).

The research in question reveals that the polluting acidification is a result of the acidifying potential of heavy metal sulphides (Pb, Cd, Cu, Zn) and sulfur oxides.

b) Heavy metal (Pb, Cd, Cu, Zn) in soils:

This process of accumulation-contamination of heavy-metals is determined and occurs for the entire period that the polluting source acts for.

Heavy metal accumulation is recessive and high in soils on the premises of the chemical plant, in the vicinity of the plant as well as on the slopes of the area that shielded and suffered from polluting emissions. (table 2).

Table 2

Distance Km	Agricultural employment	Pb	Cd	Cu	Zn
Premises of the plant	-	1012	4.2	273	384
0.4 km	Natural hayfield Arable	875 637	3.7 2.8	254	320
1 km	Natural hayfield Arable	826 248	3.7 1.2	220 94	280 108
3 km	Natural hayfield Arable	348 125	1.6 0.8	108 76	88 54
5 km	Natural hayfield Arable	88 70	0.8 0.5	65 22	64 48

Table 3.

Soil agrochemical indicator	Pedologic horizon			
	Atel Ap	Ao Ao	El El	Btw Btw
Pb	875 632	376 260	58 82	44 48
Cd	1.8 1.0	0.9 0.8	0.3 0.4	0.2 0.3
Cu	176 140	102 112	18 19	12 13
Zn	233 200	144 146	76 81	14 16

Heavy metal contamination in the superficial subhorizon of the soils is higher in natural vegetation soils (hayfield, pastureland), where existing compact plant formations and organic residues retain and maintain these heavy metals even more compared to arable lands where their tilling favours their homogenization in the soil and a migration on the soil profile.

The process of heavy metal contamination is higher along the predominant air currents and decreases as the distance to the polluting source increases.

c) Heavy metal accumulation (Pb, Cd, Cu, Zn) in plants:

Heavy metal translocation and accumulation in plants is differentiated according to the element in question, the level of soil contamination, the species and plant organ under analysis (table 4).

Table 4

Plant species	Analysis*)	Pb		Cd		Cu		Zn	
		min	max	min	max	min	max	min	max
Natural vegetation	P	39	105	0.65	1.25	17	40	90	154
	C_t	0.24	0.25	0.34	0.50	0.33	0.37	0.74	1.13
Corn-leaves	P	52	111	0.60	1.40	15	30	100	180
	C_t	0.64	0.89	0.75	0.83	0.20	0.33	1.43	1.80
Corn-grains	P	2	28	0.05	0.08	2	16	42	180
	C_t	0.02	0.22	0.03	0.04	0.03	0.19	0.56	1.80

*)P=in plant; C_t=translocation coefficient mg in the plant/mg in the soil)

The analysis of heavy metal accumulation in the plants in accordance with the absolute values of their concentrations, as well as the values of their translocation coefficients (transfer-bioavailability) indicates high values in the vegetation with photosynthetic activity (fresh plant material) compared to the seed content (except Zn, as corn is a high Zn consuming plant).

CONCLUSIONS

The process of heavy metal accumulation (Pb, Cd, Cu, Zn) in the soils is determined by the long term action of the polluting source in the area and is highlighted and favoured by severe acidity.

Heavy metal contamination is also influenced by environmental factors and location of the area- air currents, region, altitude and relief, distance from the source, land employment;

Heavy metal accumulation in the plants is higher in crops under photosynthetic activity than concentrations in the seeds.

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