LEAD ACCULUMATION IN SOIL AND THE CORRELATIONS BETWEEN LEAD CONCENTRATIONS AND SOIL PROPERTIES

ACUMULAREA PLUMBULUI ÎN SOL ŞI CORELAŢIILE CONCENTRAŢIILOR PLUMBULUI CU PROPRIETĂŢILE SOLULUI

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Abstract: *In this paper the study refers to determining the total concentrations of lead (as a reference element) in soils from Zlatna polluted area and to establishing the soils properties which influence the level of lead accumulation (soil reaction, humus content, clay content).*

Rezumat: *Studiul efectuat a urmărit determinarea concentraţiilor totale ale acumulărilor plumbului în sol în zona poluată Zlatna, ca element de referinţă al poluării, precum şi stabilirea indicatorilor solului care influenţează nivelul acumulărilor (reacţia solului, conţinutul în humus, conţinutul de argilă).*

Key words**:** *lead, organic matter, clay content, acidity*
Cuvinte cheie: *plumb, materie organică, conţinutul în argilă, aciditate*

INTODUCTION

The studied area is very well known as polluted with heavy metals, as a result of SC Ampelul SA activity, now shut-off. The degradation of the compounds of the adsorption complex is a significant process in the area and it determines an important reduction of its physical and chemical qualities.

The heavy metals accumulation in the soil depends on several of factors, such as: emission factor, the distance to the polluted source, the position of the affected perimeter facing the dominant winds, soil reaction, cationic exchange capacity correlated with texture and organic matter content, soil use, etc. The studies followed to establishing the modifications of soils, due to high concentration of lead, also to determine the correlations exist between the total content of lead accumulated in soils and some determinant properties of the soils fertility.

MATERIALS AND METHOD

For tackling the proposed targets, there have been several types of soils, from different locations of the researched area, on its entire soil profile, by studying the soil's morphological, physical and chemical parameters.

The analyses methods used for determining the soils' physical and chemical properties were those adopted in the present, in the offices' practice of the soil-cultivating and agrochemical studies in the county; ICPA, 1981- "The soil's chemical and physical analysis"; ICPA, 1986 "Methods of soil's chemical analysis"; ICPA, 1987 – "The elaboration methodology of soil-cultivating studies", part I, II and III

The determination of the lead content (total forms), which extract has been obtained through the wet disintegration in a mixture of strong acids (nitric, perchloric and sulfuric acid 2:1:0.2) and solution extract Na_2EDTA.

The correlation analysis has been accomplished by using the MstatC program.

RESULTS AND DISCUSSION

In the researched area, the soils, generally acids, become more acid in time, to 0.2-2 pH units over the initial, so we can see a great increase of the soil acidity, especially at the

level of superior horizons.

The reaction of zonal soil (pHH_2O) from the perimeter, is classified as powerfully acid, with some exceptions as in buffered soils (eutricambosols) and fluvisols, which are neutral, slightly alkalic.

Compare to unpolluted soils, characterised by light acid reaction on the entire soil profile, the poluted soils presents a powerfully modified reaction, very acid reaction through acid hydrolysis due to SO_2 and sulfurs (fig. 4.1).

The emissions from S.C.Ampelum Zlatna have determine in soil essential and long effects, regarding their acidification, due to some chemical processes, which led to sulfuric acid formation (RUSU M. şi colab, 1994). The gaseous pollutants SO_2 and SO_3 dispersed in athmosphere in combination with aqueous vapors produced acid rains. They determined the decrease of the soil pH values even under 4 (table 1), with long term acidification effects (RĂUȚĂ, 1980), materialized in washing off nutritional elements and diminishing bacterial activity in soil.

Table 1.

Soil reaction (pH H_2O) in the surface layers

Soils (*according WRB*)	**pH**	
	min	**max**
1. Haplic Luvisols	4.4	5.5
2. Stagnic luvisols	3.4	6.1
3. Rhodic luvisols	3.4	5.7
4. Albic luvisols	3.8	5.6
5. Eutric cambisols	3.3	6.3
6. Entic Aluviosols (Fluvisols)	5.5	6.4
7. Haplic Aluviosols (Fluvisols)	5.2	6.8
8. Rhodic cambic Erodosols	4.5	5.9

The evolution of the humus content is based on the assessment according to the humus content aleteration in superior layer as consequence of the mineralization and synthesis processes, is equal with the result of the algebric sums of the effects of these processes (BORLAN et al., 1991).

In the case of acidified and strongly polluted soils, the content of humificated organic matter diminishes itself. The diminishing of the humus content is obvious due to the pollution (acidification, depletion of bases and accumulation of heavy metals). The humus of the polluted soils undergoes, besides this phenomenon with a quantitative character, also a qualitative disturb, because of the content's increase of the fulvic acids, reflected by low contents of total nitrogen.

This phenomenon of quantitative and qualitative reducing was recorded in all studied soils, except some surface horizons where, under pollution impact, humus accumulation of moder type was produced.

In plants, the heavy metal accesibility is influenced by a series of edaphic factors, among them being the clay. The soil clay quantity has direct effects on the heavy metals retention. Once adsorbed by the fine fraction, they can be kept some time, or can be gradually released.

The granulometric composition of the soils from the area, reveals a significant increase of the sand and silt fractions, in the mean time with the degradation of the mineral liants and components of the adsorbtive complex.

The excesive decrease of the soil calcium quantity, associated to low clay content, and reducing of the organic component, directly affects the soil buffering capacity and its structure. In majority of cases, the A horizon is, in best situations, moderate structured, rich in grains, angular or subangular polyedric, with small or small-average sizes agregates.

Thus, the heavy metals are concentrated within the adsorbtive complex and soil solution, in surface horizons especially, at levels which often are over the tolerance values of the ecosystems' components, concerning lead, especially, which is the main pollution agent and is accumulated in biggest quantities (table 2).

Table 2

The levels of lead accumulation (total content, in ppm)

No. Crt.	Type of soil (WRB)	Horizons	Depth	Pb total content (ppm)
1.	Haplic Luvisol (Pătrunjeni)	Ao1	0-5	984
		Ao2	5-15	249
2.	Stagnic Luvisol (Pătrânjeni)	Ap	10-20	159
3.	Stagnic Luvisol (Pătrunjeni)	Aţ	5-10	226
4	Rhodic stagnic Luvisol (Valea lui Paul)	Aţ	10-15	349
5.	Rhodic stagnic Luvisol (Zlatna)	Ao	0-5	453
		El	15-25	237
6.	Rhodic stagnic Luvisol (Valea mică)	Ao	0-3	611
		El1	10-15	92
7.	Rhodic stagnic Luvisol (Zlatna, Galaţi)	Aţ	0-8	312,5
		El	8-27	177
8.	Albic Luvisol (Zlatna)	Ao1	0-10	242,5
9.	Albic stagnic Luvisol (Zlatna)	Aţ	0-10	243
10.	Eutricambosol (Presaca Ampoiului, aval)	Ap	5-15	145
11.	Eutricambosol (Presaca Ampoiului, pădure)	Ao1	0-5	241
		Ao2	5-10	107
12.	Entic Aluviosol (Presaca Ampoiului, luncă)	Ap	5-15	130
13.	Haplic Aluviosol (Pătrânjeni)	Ap	10-20	246
14.	Haplic Aluviosol (Pătrunjeni)	Ap	10-15	601
15.	Haplic Aluviosol (Pătrunjeni)	Ap	5-15	249
16.	Rhodic cambic Erodosol (Pătrunjeni)	Ao1	0-5	178

The lead accumulation is over the maximum admitted limits (over 100 ppm), in all analyzed soils, at surface horizon level, especially. The values are very small at depth bigger than 30 - 40 cm (Laura PAULETTE, 2004).

The accumulation of the heavy metals in soil depends on many factors, as: emission, distance from emission source, the position of the affected area reported to the dominant winds, soil reaction, the capacity of the cationic change correlated to the organic matter content, texture, land use, etc.

Besides the decrease of the soil reaction (fig. 1) the lead accumulation in Stagnic Luvisoils is also determined by the high humus content, H = 3.5 – 5.4%, as result of stable compounds formation, the determined values being statistically assured by a very significant coefficient of correlation, r = 0.87 (fig. 2).

Some particular traits were reported for the Albic Luvisoil. As consequence of the low clay content and increase of the pH values, direct relationship with a coefficient of correlation of r = 0.66, the lead accumulation is more accentuated and is in direct relationship with humus (fig. 4) and opposite relationship with soil reaction for lead, r = -0.88 (fig. 5).

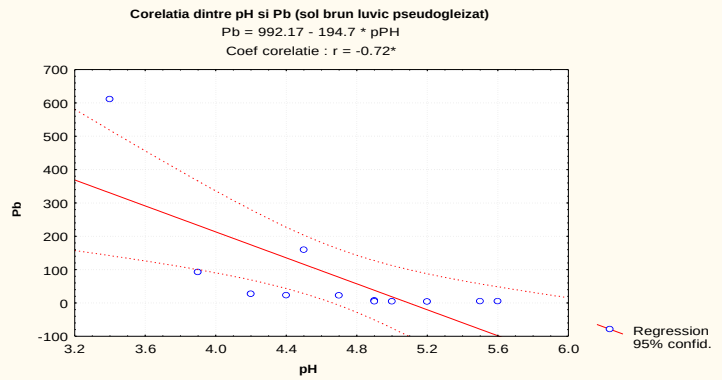

Fig. 1. Correlation between soil reaction and Pb on Stagnic Luvisols

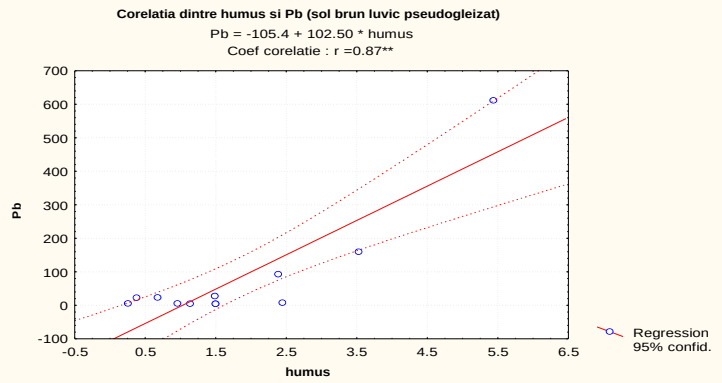

Fig 2. Correlation between humus content and Pb on Stagnic Luvisols

In Rhodic Stagnic Luvisoils, characterized by high humus content, the same accentuated acummulation is found, materialized in tight relationships, with significant coefficients of correlations for the relationship organic matter and lead (figure 3).

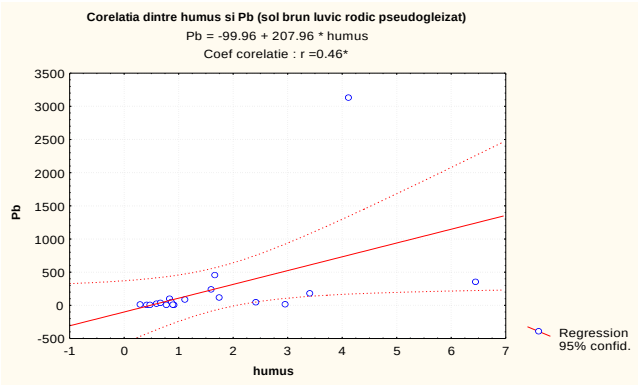

Fig 3. Correlation between humus content and Pb on Rhodic Stagnic Luvisols

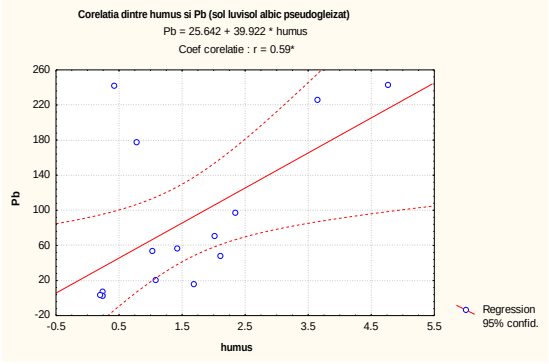

Fig 4. Correlation between humus content and Pb on Albic Luvisols

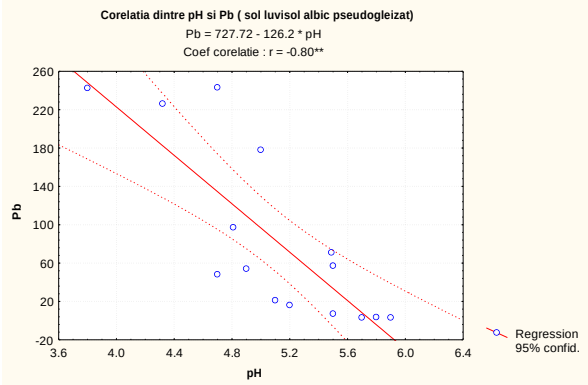

Fig 5. Correlation between soil reaction and Pb on Albic Luvisols

For the eumesobasic soil, very significant coefficients of correlations with pH-ul (r = -0.75) and clay content (r = -0.71) were determined for lead (table 3).

Due to the weak acid – neutral soil reaction and soil enrichment in heavy fractions, the lead accumulation in Aluviosoils was low, this being revealed by the not significat coefficients of correlation (table 4).

Table 3

The regression coefficients in Eutricambisoils

Indicator	Pb
pH	**-0.75**
Humus	0.69
Clay	**-0.71**

Table 4

The regression coefficients in Aluviosoils

Indicator	Pb
pH	-0.14
Humus	0.38
Clay	0.32

In Rhodic Cambic Erodosoils, the lead accumulation was reduced, and physico-chemical properties of the soil were not essentially modified by the presence of this element.

CONCLUSIONS

Experimental research showed the following:

- ✓ The basic pollution element is lead. For this element, values over Maximal Adimtted Limits were recorded. The accumulation level depends on the distance from the pollutionn source and soil components.

- ✓ The lead pollution determined acidifiation with 1 – 2 pH units compared to the values of the same type of soil located in not polluted areas. The researched soils recorded wide diversity of values, very acid and acid preponderently. The acidity resulted from their nature, but also from the pollution.
- ✓ The indices of the studied soils recorded a high diversity, connected to the pollutant effect and location from the pollution source. As close are from the pollution source, as strong is the acidifiation.
- ✓ In all analyzed soil types (except erodosoils), an inverse correlation was recorded between soil reaction and lead accumulation level, expressed by very significant coefficients of correlation, which reveal the simultaneous increase of total lead concentration with decrease of the pH values.
- ✓ The correlation between the humus content and the level of heavy metals accumulation is emphasized in all soils. Between these components, a direct relationship was reported, a big humus content leading to formation of stable lead compounds.
- ✓ Due to the degradation of the components of the adsorbtive complex, in time, the granulometric composition of the soils, supported an increase of the sand and silt fractions, in detriment of clay, which determines a weak lead retention, in acid soils especially, and they can be easily absorbed by plants.
- ✓ In affected area, the pollution effect is directly recepted on the agricultural and forestry vegetation, by reducing the vegetation density. Even its disapearance can be recorded, as herbal vegetation situation, which advantaged the soil degradation through erosion.

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