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THE NITROGEN REGIME AND MOBILITY OF SOME TRACE ELEMENTS IN ARABLE SOILS LOCATED NEAR THE TAILING PONDS IN THE WEST PART OF BAIA MARE

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Abstract

Depression of the Baia Mare is known like an area strongly affected by the mining activities performed here the centuries.These activities have generated important polluted areas, which even today, are subject directly to the pollutant impact. This paper presents the results of research conducted in the experimental plots, located near the tailing ponds, from the west part of Baia Mare. The chemical analyses conducted at the beginning of the study showed a small content of the total nitrogen, a high content of micro nutrients – copper, manganese and zinc, and specific pollutant – lead, and acidic reaction of the soil. Differentiated fertilisations applied, does not demonstrates that this fact affect the mobilization and accessibility of the four metals and indicating therefore, the possibility to be translocated in the throphic chain soil-plant-human. The study demonstrates the needs to implement urgent measures for environmental remediation of these soils to restore agricultural capacity of these soils.

Key words: *fertilizations, micronutrients, nitrogen, specific pollutants, tailing ponds.*

INTRODUCTION

The forced industrialization of our country in the last century, including the strong development of activities in the ferrous ore mining and processing fields in Baia Mare depression has left a strong imprint on the environment. Studies show that large areas of land in this area are polluted. The most heavily polluted areas are occupied by the mine tailings dumps, including their adjacent surfaces (SNR-SS, 2006).

After 1989, through the implementation of the Land Law, while the economic decline and the population migration from urban to rural were taking place, newly regained lands began to be utilized for subsistence agriculture. Although, in most cases, there are no studies regarding the suitability of land in heavily polluted areas, these lands are cultivated every year with maize, potato, triticale and other economic useful plants (Muntean, 2012).

THE RESEARCH AREA

The ultimate goal of our research is to establish appropriate agro-technical measures for sustainable agriculture, in order to obtain our goal we have chosen for the experiments two rectangular plots with an area of approx. 600 m^2 located upstream and downstream of the three dams: Sasar, Remin and Aurul. This site is located in the west of Baia Mare depression plain, on the estate of the villages Sasar (S) and Bozanta Mare (B), at an average altitude of 170 m (Figure 1).

Figure 1. The geographic localization of the experimental area (Source: www.google.earth)

As we can see in the figure above, the experimental area is located on the first terrace of the river Sasar, the soil of this area falling within the following soil types:

- Stagnosol-typically strong stagnosols, clay, eluvial materials medium carbonated/non-carbonated clays, moderately compacted soil arable-Lot for the upstream;
- Distric gleyosol, strongly gleyed, clay, eluvial materials carbonated/non-carbonated clay, arable soil, for the downstream.

MATERIALS AND METHODS

Each batch has been parceled into 3 equal areas, one of which was the witness surface and the other two were fertilized as follows: one with chemical fertilizer (calcium) and one with organic fertilizer, manure. In 2011 agricultural plots were cultivated with maize, the Pioneer PR 38A-24 sort, and in 2012 we have planted a potato crop, variety Labadie.
To establish the baseline concentrations of micronutrient elements of the soil we have taken samples in the late March of 2011, when the soil temperature exceeded the critical threshold of 5°C. The last soil samples have been collected in October 2012. The soil sampling has been performed according to standard STAS 7184/1: 1984-Soils, Sampling for Soil Survey and agrochemicals. The harvesting has been done at a depth of 0-40 cm in new polyethylene bags. The samples have been labeled and transported immediately to the laboratory for analysis. The protocol lift of soil samples is highlighted in the following figure (Figure 2).

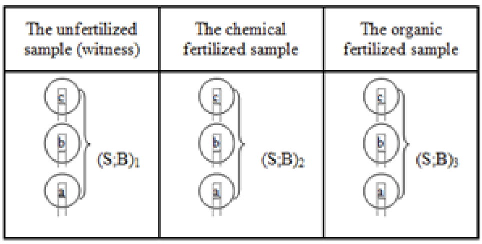

Figure 2. The sampling protocol

The soil reaction (pH) was determined in aqueous solution according to standard analysis STAS 7184/13: 2001- Soils, Determination of pH. The determination of macronutrients-nitrogen was performed according to standard ISO 11261-2000-Soil quality, Determination of total nitrogen, Kjedhal modified method.
Determining the form of pseudo-total trace elements of interest (copper, zinc, cadmium and lead) soil samples were processed according to standard ISO 11466:1999-Soil quality. Extraction of trace elements soluble in water, as total metals was determined according to the standard ISO 11047:1999-Soil quality. Determination of cadmium, chromium, cobalt, copper, lead, manganese, nickel and zinc in aqua regia soil extracts using Atomic absorption spectrometric method in Flame and electro thermal. For determining the availability of transfer through food chains, the metal concentration was determined according to the Soil Survey Methodology develop (MESP), simultaneous extraction method combined with a solution of 0.01 M EDTA-CH3COONH4 1N at pH = 7.0. Appropriate concentrations of micronutrients were also determined by atomic absorption spectrometry graphite furnace technique.
The interpretation of the results was performed in accordance with Order 756/1997,the approved legislation on environmental pollution assessment, i.e. Annex 1: Reference values for trace elements in soil chemical for use sensitive soils (Ordin 756,1997) and with the ICPA (ICPA, 1987).

RESULTS AND DISCUSSIONS

After analyzing the soil samples collected, we have obtained the following results:
The determinations regarding the **soil reaction** revealed that these soils are mainly moderately acidic and weakly acidic (Kabata-Pendias, 2006, Muntean, 2012), such as shown in Table 1.

Table 1. Values of the soil reaction in the batch upstream (S1-S3) and downstream group (B1-B3)

Sample code	2011		2012	
	Before seeding	After harvest	Before seeding	After harvest
S1	5.16	5.23	5.20	5.18
S2	5.42	5.46	5.53	5.33
S3	6.05	5.88	5.73	5.80
B1	5.80	5.68	5.85	5.72
B2	6.41	6.30	6.26	6.25
B3	5.85	5.70	5.68	5.80

The total content of nitrogen in the samples taken shows small and medium concentration, the gap values determined in 2011 - 2012, 0099 - 0119% for the group being downstream and upstream 0113 - 0150% for the group. The annual average values for each plot of the experimental groups are shown in Table 2.

Table 2. Annual average concentration of total nitrogen in the experimental lot

Annual medium values of the total nitrogen,%		
Samples code	**2011**	**2012**
S1	0.118	0.113
S2	0.138	0.138
S3	0.148	0.150
B1	0.104	0.099
B2	0.102	0.104
B3	0.115	0.119

The content of potentially toxic trace elements reveals that all their mobile forms for soil exceeding normal values provided by applicable law as follows:
-the determined concentrations for copper show exceptionally high supplies, the recommended value (20 mg/kg dry. dried) is being surpassed at least 4.5 times for the downstream lot and 52.4 times in the upstream lot:

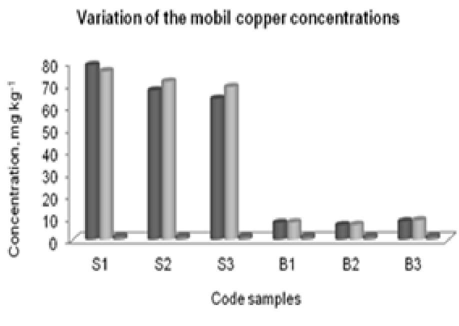

Figure 3. The mobile forms of copper concentrations

-the indicate zinc concentrations determined reveal high supplies, the recommended value (100 mg / kg dry. dried) being surpassed at least 7.1 times for the downstream lot and at most 31.5 times for the upstream lot;

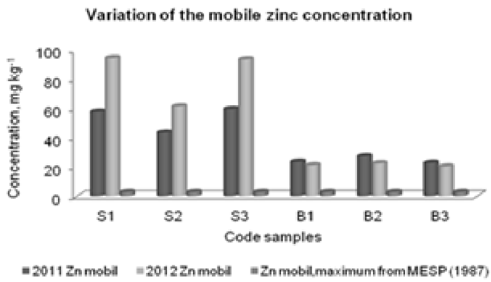

Figure 4. The mobile forms of zinc concentrations

-the manganese concentrations indicate a high supply, the recommended value (900 mg / kg dry. Dried) being surpassed at least 4.0 times for the downstream lot and 6.1 times for the upstream lot;

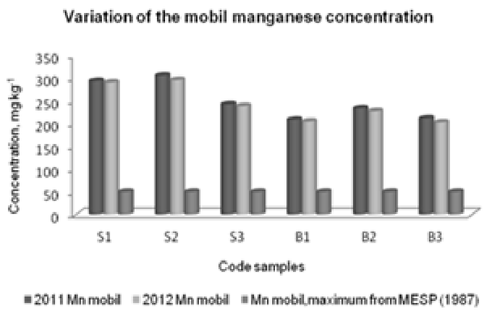

Figure 5. The mobile forms of manganese concentrations

-the concentrations determined for lead due show the exceeding of the recommended amount (20 mg / kg dry. dried) in both lots. This element shows the maximum overtaking in the samples taken upstream-6.6-8.3 times the normal amount indicated in Annex 1 of Order no. 756/1997 for sensitive use of soils

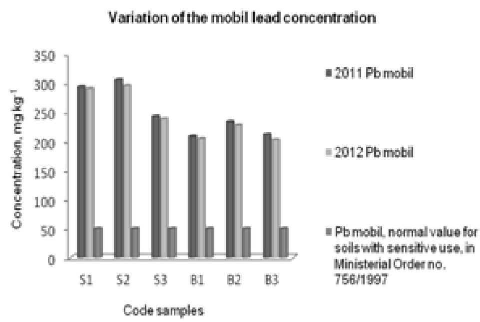

Figure 6. The mobile forms of lead concentrations

The Pearson correlations calculated using the Pearson function in Microsoft Office Excel application, of the concentrations of trace elements show negative correlations in the following order: The Mn > Pb > Zn.

CONCLUSIONS

The results show that:

-the adjacent lands soils in from the western tailings of Baia Mare show significant concentrations that exceed the rules laid down by legislation in force;

-the reaction of the soils is mostly acidic for both groups and the concentration of total nitrogen, essential macro nutrient in plant development is low for both groups;

-the concentrations of trace elements in mobile form presents high values in both groups, but especially in the lots located upstream the tailings dams;

-the lead pollution of this area is significant even if industrial processes have taken steps to protect the environment and have reduced or ceased their activity.

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