EVALUTION OF POLLUTION WITH HEAVY METALS IN BARZAVA RIVER, ROMANIA

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ABSTRACT

In Caras-Severin County the non-renewable natural resources were and are still exploited and processed with technologies that led to heavy pollution of areas. Barzava, tributary of Timis River, springs on the mountain Semenic, cross the Resita town, the county seat, and collects wastewaters from numerous companies most producing pollution with heavy metals. Heavy metals determination (Cr, Se, As, Fe, Cu, Pb, Zn, Cd, Ni) was made in samples collected (in four points) from Barzava river and from his affluent Terova creek (samples from three points) which crosses the northern area of biggest and oldes sterile dump generated by metallurgical industry. Considering the maximum allowed concentration for heavy metals in surface waters, we found that Barzava waters at springs and at the entrance of the city Resita may be enrolled in class of quality I for surface water, but out of town, Cu content exceeds the permissible limit and after Bocsa city Pb exceeds allowable limits for this category of surface waters. Considering the higher content of Cr, Cu, Fe, Mn, Ni, Terova creek can be classified as quality water II, metals being entrained when the creek crosses the sterile dump area. Of course, Terova creek laden with heavy metals affects the quality of Barzava River. Resita town captures drinking water from clean sources (accumulation lakes, Barzava upstream), but pollution with some heavy metals in and out of town affects the water quality in downstream cities and villages, where, in addition, local agro-industrial discharges of waste waters in Barzava River increase their pollution.

RESEARCH REGARDING HEAVY METALS CONCENTRATIONS IN WILD FLORA GROWING ON A CONTAMINATED SOIL IN SERBIA (BORSKI MINING AREA)

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ABSTRACT

Heavy metal toxicity has become a large concern for Serbia, due to the contamination of soil and water streams from Borski Mining Area. Plants and the associated soil samples collected from polluted and unpolluted sites, from Borski Mining Area, were analysed for Cu and Zn, using a simultaneous inductively coupled plasma atomic emission spectrometer produced by Spectro model Ciros Vision. The selected native plants were *Tussilago farfara* L., *Calamagrostis epigejos* (L.) Roth., *Phragmites australis* (Cav.) Steud., *Urtica dioica* L., *Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb., *Sambucus nigra* L., *Typha latifolia* L., *Salix cinerea* L., *Juncus effusus* L., and *Mentha longifolia* L. Bioconcentration Factor (BCF) showed that *Petasites hybridus, Tussilago farfara, Urtica dioica and Mentha longifolia* can be used for phytoremediation of contaminated soils.

INTRODUCTION

The mining activities have a serious environmental impact on soils and water streams, generating millions of tons of mine tailings [1] and high amounts of sterile materials for many years [2]. Soil pollution by trace elements due to mining and smelting activities is a worldwide problem. The mine tailings are potential sources of pollution due to wind and water erosion [3]. Efforts to restore a vegetation cover can benefit stabilization and pollution control [4]. Therefore, the use of plants to remediate soil contamination is considered as a highly promising approach for improving the environmental quality of the site [5]. The use of plants may be an alternative means of decreasing the environmental risk posed by mine tailings [6]. The environmental impacts of mining activities in southeast Serbia (Borski Mining Area) include large areas of soils characterized by accumulation of heavy metals.
The objective of this paper was to determine heavy metals distribution in soils and plants from Borski Mining Area, to search plants that have spontaneously colonized these sites and are completely adapted to these polluted environments.

MATERIALS and METHODS

Plants and the associated soil samples from Borski Mining Area were collected from five locations: Zmaevo, Lutarica River valley, Bella Reka River valley, Borska River valley and

Ravna Reca River valley. The samples were analyzed for metal concentrations (Cu and Zn). The ten species of native plants (*Tussilago farfara* L., *Calamagrostis epigejos* (L.) Roth., *Phragmites australis* (Cav.) Steud., *Urtica dioica* L., *Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb., *Sambucus nigra* L., *Typha latifolia* L., *Salix cinerea* L., *Juncus effusus* L., *Mentha longifolia* L.) were collected, as well as the soil below the plants. Plant and soil extracts analysis, was performed at Mining and Metallurgy Institute Bor Laboratories, using a simultaneous inductively coupled plasma atomic emission spectrometer produced by Spectro model Ciros Vision. Data resulted from the analysis of soil samples have been compared with the reference values for metal contents (mg/kg of D.M.) in soils, according to the MAPPM Order 756/1997 [7]. In order to estimate a plant's potential for phytoremediation purpose we used two parameter named the Bioconcentration Factor (BCF = metal concentration of plant (Leaves + steam) / metal concentration of soil) and Translocation Factor (TF = metal concentration of plant (Leaves + steam) / metal concentration of root) [8].

RESULTS

In order to study of phytoremediation polluted soils these sites, we have searched plants that have spontaneously colonized mine tailings from ancient times and therefore are completely adapted to these polluted environments [9].

Table 1. Copper concentrations in topsoil and plant samples (mg kg^{-1}) from Borski Mining Area

Site	Sampling points	Species	Leaves + steam	Root	Topsoil	Translocation factor (TF)	Bioconcentration factor (BCF)
SI: Zmaevo	P1	*Tussilago farfara* L	563.6	821.1	497	0.68	**1.13**
	P2	*Calamagrostis epigejos* (L.) Roth	106.9	218	1491.6	0.49	0.07
	P3	*Phragmites australis* (Cav.) Steud.	437.4	473.5	1097.5	0.92	0.39
SII: Lutarica River valley	P4	*Urtica dioica* L.	73.9	345.5	1747.9	0.21	0.04
	P5	*Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb.	363.5	250.3	324.1	**1.45**	**1.12**
	P6	*Sambucus nigra* L.	127.1	85.2	363.6	**1.49**	0.34
SIII: Bella Reka River valley	P7	*Phragmites australis* (Cav.) Steud	369.6	213.7	3770.8	**1.72**	0.09
	P8	*Tussilago farfara* L.	402.9	1084.6	4433.8	0.39	0.09
	P9	*Salix cinerea* L.	81.1	2271	3982.5	0.03	0.02
SIV: Borska River valley	P10	*Typha latifolia* L.	274	370.7	6283.1	0.73	0,04
	P11	*Salix cinerea* L.	131.1	1822.3	6215.6	0.07	0.02
	P12	*Juncus effusus* L.	201.4	2801.3	5851.6	0.07	0.03
SV: Ravna Reca River valley (control)	P13	*Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb.	29	47.8	37.6	0.60	0.77
	P14	*Mentha longifolia* L.	149.8	491.3	42	0.30	**3.56**
	P15	*Urtica dioica* L.	20	134.7	48.4	0.14	0.41

Concentration of heavy metals (Cu and Zn) varied among the plant species as shown in Table 1 and 2. Considerable amount of Cu (e.g. 563.6 mg kg^{-1} in leaves + steam and 2801.3 kg^{-1} in root) and Zn (e.g. 224.3 mg kg^{-1} in leaves + steam and) were found to accumulate in almost all the plants grown on contaminated soil. Concentration of metals in soil was correlated with their concentration in plant (BCF).

Table 2. Zinc concentrations in topsoil and plant samples (mg kg^{-1}) from Borski Mining Area

Site	**Sam-pling points**	**Species**	**Leaves + steam**	**Root**	**Topsoil**	**Translo-cation factor (TF)**	**Biocon-centra-tion factor (BCF)**
SI: Zmaevo	P1	*Tussilago farfara* L	102.5	129	87.8	0.79	**1.16**
	P2	*Calamagrostis epigejos* (L.) Roth	23.5	20	137.5	**1.17**	0.17
	P3	*Phragmites australis* (Cav.) Steud.	160.3	224.9	140.4	0.71	0.007
SII: Lutarica River (Cerovo)	P4	*Urtica dioica* L.	159.2	109.2	106.7	**1.45**	**1.49**
	P5	*Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb.	224.3	142.2	222.1	**1.57**	**1.00**
	P6	*Sambucus nigra* L.	31.7	57.2	231.1	0.55	0.13
SIII: Borska +Kriveljska River valley	P7	*Phragmites australis* (Cav.) Steud	52	61.3	2294.1	0.84	0.02
	P8	*Tussilago farfara* L.	113.1	286.4	3241	0.39	0.03
	P9	*Salix cinerea* L.	85.8	1071.7	2923.3	0.08	0.02
SIV: Borska River	P10	*Typha latifolia* L.	131.5	187.2	7150.5	0.70	0.01
	P11	*Salix cinerea* L.	151.6	975.6	6521.7	0.15	0.02
	P12	*Juncus effusus* L.	93.2	2583.8	7170.6	0.03	0.01
SV: Ravna Reca River (control)	P13	*Petasites hybridus* (L.) P. Gaertn., B. Mey et Scherb.	15.7	17.3	73.5	0.90	0.21
	P14	*Mentha longifolia* L.	31	31.4	70.5	0.98	0.43
	P15	*Urtica dioica* L.	24.3	50.4	71.9	0.48	0.33

Data of Table 1 and 2 show that the plants studied can be used for remediation of contaminated soils. According to Conesa [6], results demonstrate that the plants growing on the mine tailings Borski Mining Area, were adapted to high concentrations of heavy metals in the soil and may have the potential for phytoremediation.

CONCLUSIONS

The values of the BCF and TF show that different plant species reveal higher accumulation capacity for Cu and Zn. Copper Bioconcentration Factor (BCF) showed that *Mentha longifolia, Petasites hybridus and Tussilago farfara* can be used for phytoremediation of contaminated soils. Copper Translocation Factor (TF) showed that *Phragmites australis, Petasites hybridus and Sambucus nigra* can also be used for phytoremediation of contaminated soils. Results show that accumulation of metals by plants depends not only on the concentrations and categories of heavy metals in soil were they grow but also from the plant species [10,11].

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