In-situ Bioremediation of Contaminated Soils in Mining Areas from Rodna, Bistri□a-Năsăud

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Abstract

Soil ecosystems contaminated with heavy metals can cause significant damages to the environment and human health due to the mobility and solubility capacity of the contaminants. This research was carried out to set up a suitable bioremediation scheme for cleaning up the soil from the mining sites of Anieş and Glod Valley from Bistriţa-Năsăud county. Based on the investigations that have been made (soil colour, pH, organic content of the soil, plant inventory) phytoremediation seemed to be the most effective and environmentally-friendly method that could be used to neutralize or remove heavy metals from the soil.

Keywords: *bioremediation, heavy metals, plants, soil*

Introduction

Heavy metals are considered to be a significant environmental issue for human health. The contamination of soil and water bodies by pollutants and toxic metals have been increased for the past few years due to metallurgical industry era, and anthropogenic activity in imbalanced proportions. Bioremediation is a unique and cost-effective technique for cleaning up pollution by intensifying the natural biodegradation processes and refers to the translocation of metal contaminants from soil up to the above-ground tissues by the root system (Garbisu and Alkorta, 2003). There are a large number of biological methods that can be used to remove the hazardous metal content from soil and water such as phytoremediation, phytoextraction, rhizofiltration, phytostabilisation and phytovolatilisation (Pulford and Watson, 2003). The bioremediation period depends on the type and extent of heavy metal contamination, the duration of the growing season, the amount and characteristics of the produced biomass, and the heavy metal accumulation capability of the plants.

Aims and objectives

The main aim of this research was to reduce heavy metal contamination level of the soil in mining areas of Rodna by adopting a three-step soil remediation scheme. In the first step chemical and physical analysis of the soil was made followed by plant and bioremediation method selection specific to these sites.

Materials and methods

Soil samples for this experiment were taken from two mining sites, namely Anieş and Glod Valley. In total, 30 soil samples were taken in August 2016 from the studied areas (29.30 hectares), to be analyzed in accordance with the standard SR ISO 11464/1998- Soil quality samples pre-treatment for physical-chemical tests. The sampling depths varied between 0-20 cm, 20-40 cm and 40-60 cm, and were taken with a handle steel soil sampler. The pH of the soil was analyzed according to SR ISO 10390/1999-Soil quality. The organic matter of the contaminated soil was determined by using Tiurin method. The Reddish Brown colour (2.5YR 5/4) of the soil was examinated in terms of Munsell notations obtained by visual comparison of the samples to the Munsell soil color chart.

Results and Discussion

The Anieş and Glod Valley pit lakes were formed due to the heavy metal mining activities

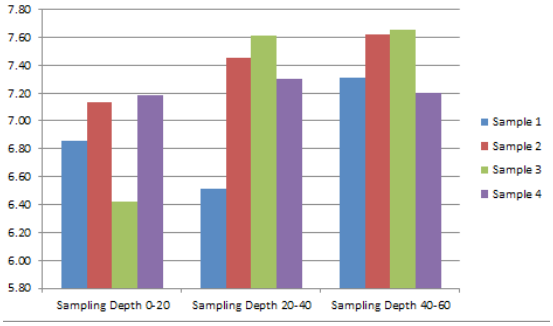

Fig. 1. pH values of Anies site

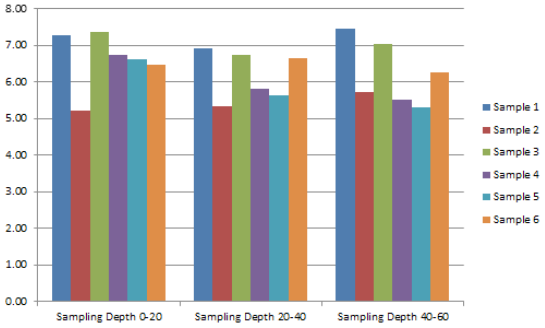

Fig. 2. pH values of Glod Valley site

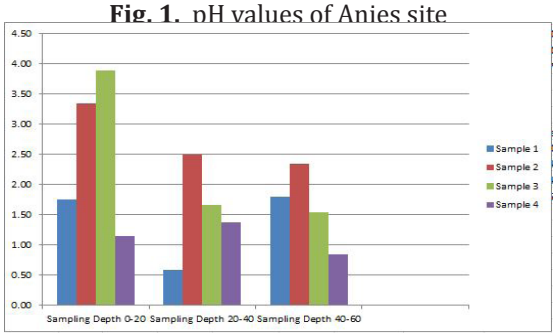

Fig. 3. Organic content of Anies site

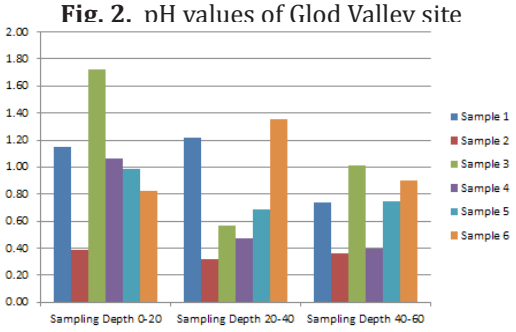

Fig. 4. Organic content of Glod Valley site

from 1973 in Rodna (Bistriţa-Năsăud county). Around the Anieş pit lake 11 terraces were consolidated: width of 3,8-4,0 m and a height of 2,5 m having an inclination angle of 45-50°. The soil study that have been made indicates that tailing deposits are not homogenous in the context of soil composition and permeability; the water-holding capacity values of the soil are low. Nutrients distribution varies considerably at the root system level.

As it is shown in Fig. 1 and 2 soil reaction (pH) was within the range of 5.22 and 7.65. The mean value of the pH was 6.67, near to the optimal value. The results of the organic content analysis are shown in Fig. 3. and 4.; the values ranged between 0.32 and 3.89, showing a low to medium organic matter content. The reddish brown colour of the soil indicates the presence of heavy metals in the area (Pb, Mn, Fe, Cu, Zn) that lessen plant growth and development in these areas. The colour of the lake water is greyish, with a low number of plant species.

During the research several plant species were identified on these sites. The dominant species are herbaceous plants that proved to be more resistant to contaminated soil conditions than trees (*Lathyrus vulgaris, Carex sp., Typha sp.*, *Rumex sp.*, *Robinia pseudacacia, Pinus nigra*). Undoubtedly, because of the unfavorable soil conditions a great number of tree species are shrivelled.

Conclusion

Establishing and managing tree plantations or other herbaceous species in Rodna mining areas seems an appropriate and successful technology for future practitioners. The most effective plants used for phytoremediation are: *Brassica juncea L., Salix species-especially white willow, Populus deltoides, Sorghastrum nutans, Helianthus Annuus L., Scirpus cyperinus, Schoenoplectus tabernaemontani, Rudbeckia laciniata, etc.* These species have a great absorbtion capacity of heavy metals (chrome, copper, lead, magnesium, nickel, zinc) to uptake, store and degrade contaminants within their tissues.

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