Phytoremediation of Mine Influenced Waters: Comparing the Efficiency of Alyssum, Virginia Mallow and Giant Miscanthus in Removing Metals.

Martyna Lalik[1]

[1]*University of Silesia, Faculty of Natural Sciences, Będzińska 60, 41–205 Sosnowiec, Poland, martyna.lalik@us.edu.pl, ORCID 0009-0007-2515-2800*

Abstract

Mine influenced waters, rich in metals, pose a significant environmental challenge due to their toxicity and potential effects on ecosystems and human health. The contamination of mine-influenced waters with metals such as chromium (Cr), cadmium (Cd), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn) represents one of the most pressing ecological challenges. Given the toxicity of these elements to living organisms and their persistence in the environment, developing effective and sustainable methods for their removal is a priority. Phytoremediation, which utilizes the natural ability of plants to accumulate metals, offers a promising alternative to costly physicochemical technologies.

The review of studies and experiments focused on phytoremediation using Giant Miscanthus (Miscanthus × giganteus), Virginia Mallow (Sida hermaphrodita), and Alyssum (Alyssum spp.). The comparison of the plants' effectiveness in environmental remediation was based on the bioconcentration factor (BCF), bioaccumulation factor (BF), and translocation factor (TF).

Research findings revealed that Virginia mallow exhibits higher accumulation capacities for metals such as zinc (Zn) and cadmium (Cd), attributed to its well-developed root system and biomass accumulation capabilities. Conversely, giant miscanthus, due to its rapid biomass growth and tolerance to harsh environmental conditions, effectively removes contaminants on a larger scale, making it more efficient overall. Studies on alyssum indicated that its capacity for cadmium (Cd) and nickel (Ni) accumulation is considerable in controlled conditions; however, its effectiveness in water remediation is limited compared to other studied species, and it cannot be classified as a suitable accumulator for pollutants. The results highlight that the efficiency of phytoremediation depends on environmental factors such as pH, metal availability, and the physicochemical characteristics of soil and water. Additionally, employing supportive technologies, such as the addition of chelators or microorganisms that enhance plant growth, can further improve the efficiency of this process.

The potential of phytoremediation as a tool for reducing metals is substantial. Environmental remediation using this method aligns with sustainable development principles and is economically advantageous compared to traditional remediation methods. Field studies, the integration of various approaches, and the development of supporting technologies can further enhance the effectiveness and applicability of this technology in the removal of pollutants from mine influenced waters.

Keywords: Phytoremediation, metals, mine influenced waters, contamination

References

Bang J, Kamala-Kannan S, Lee KJ, Cho M, Kim CH, Kim YJ, Bae JH, Kim KH, Myung H, Oh BT (2015) Phytoremediation of Heavy Metals in Contaminated Water and Soil Using Miscanthus sp. Goedae-Uksae 1. International Journal of Phytoremediation, 17(6), 515–520, doi: 10.1080/15226514.2013.862209

Kocoń A, Jurga B (2017) The evaluation of growth and phytoextraction potential of Miscanthus x giganteus and Sida hermaphrodita on soil contaminated simultaneously with Cd, Cu, Ni, Pb, and Zn. Environmental Science and Pollution Research, 24, 4990-5000, doi: 10.1007/s11356-016-8241-5

Nurzhanova A, Pidlisnyuk V, Abit K, Nurzhanov C, Kenessov B, Stefanovska T, Erickson L (2019) Comparative assessment of using Miscanthus× giganteus for remediation of soils contaminated by heavy metals: a case of military and mining sites. Environmental Science and Pollution Research, 26, 13320-13333 , doi: 10.1007/s11356-019-04707-z

Pusz A, Wiśniewska M, Rogalski D (2021) Assessment of the Accumulation Ability of Festuca rubra L. and Alyssum saxatile L. Tested on Soils Contaminated with Zn, Cd, Ni, Pb, Cr, and Cu. Resources, 10(5), 46, doi: 10.3390/resources10050046