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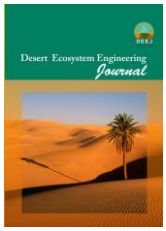

Investigating Phytoremediation of Soils Contaminated with Heavy Metals of *Lycium Depressum* L Plant: A Case Study of Iodine Factory of Golestan Province

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Background and objectives

Operating factoriws are among the main sources of pollution especially in arid and semi-arid areas due to soil erosion and accumulation of plants, bringing about adverse consequences for the environment. Therefore, this study sought to investigate the phytoremediation potential of the Lycium depressum Stocks and determine the shape, size, and the composition of the synthesized particles in terms of the intensity of As, Ni, Cr, Co, and V metals accumulated on the plant's aerial organs due to the activity of iodine factory in Golestan province using FESEM and EDX microscope. It should be noted that the reason for choosing the aforementioned tree species is that the plant is native to and dominant in the region, thus providing high chances of establishment in the study area.

Materials and methods

Characterized by *Lycium* genus and Sloanaceae family origin, Lycium depressum L. is the only native perennial tree-like species in the region, being known as a salt and drought tolerant plant. Recently, the species has been planted in Iran by Golestan Province's Natural Resources and Watershed Management Department to promote vegetation. For research purposes of this study, the required samples of *L.depressum* species were randomly collected from the iodine factory at five distances of 12.52, 12.75, 15.14, and 13.97 kilometers, respectively (W_1, W_2, W_3, W_4, W_5) using cross-sections extracted from the stem and roots of the plant. Moreover, the shape, size, and composition of the synthesized particles were checked using FESEM and EDX microscopes. Then, the concentration of the intended metals accumulated on the aerial orgnas and roots of the collected samples was calculated through an atomic absorption device.

Results: According to the results of the study, the average concentration of Ni, Co, V, Cr, and AS in *L. depressum* samples was found to be 11.35, 675.78, 30.83, 246.72, and 55.34 mg/kg, respectively. Moreover, the highest and lowest concentration of the metals belonged to Ni and AS, respectively, followed by Co, V, and Cr. On the other hand, the highest concentration of the metals at W_5, W_4, and W_2 distances were reported in aerial organs, while at the other two distances (W_1 and W_3), the concentration was found out to be higher at the plant's stems than in its roots.

The results of the metal Transfer Factor revealed that the average rate of Transfer Factor for Ni, Co, As, Cr and, V was greater than one in W_1 and W_3, being reported to be 1.42, 1.38, 1.19, 1.38 mg/kg, and 1.10 in W_1, and 1.13, 1.12, 1.06, 1.12, and 1.15 mg/kg in W_3, respectively). However, the average rate of the factor was near one

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at W_2 and less than one W_5, W_4 for Ni, Co, As, Cr, and V, being reported to be 0.96, 0.96, 0.98, 0.96, and 0.96 mg/kg at W_2, respectively; 0.85, 0.87, 0.93, 0.87, and 0.92 mg/kg at W_4, respectively, and 0.47, 0.50, 0.66, 0.50, and 0.82 mg/kg at W_5, respectively). Moreover, the average rate of the Transfer Factor was less than one Ni, Co, As, Cr, and V at all distances (W_1: 0.41, 0.39, 0.43, 0.39, and 0.42 mg/kg, respectively; W_2: 0.42, 0.41, 0.44, 0.40, and 0.43 mg/kg, respectively; W_3: 0.41, 0.39, 0.43, 0.39, and 0.40 mg/kg, respectively; W_4: 0.49, 0.47, 0.49, 0.46, and 0.46 mg/kg, respectively; W_5: 0.67, 0.65, 0.55, 0.64, and 0.49 mg/kg, respectively). Furthermore, the results of the combination of chemical elements in *L. depressum* samples showed that C and O were the dominant elements in all five samples, and some elements such as K, Cl, and Ca were observed in many of the stems and roots of the collected samples. However, some elements were found to have lower percentages (P, S, Si, Fe and Al) in the roots of the samples.

Conclusion: Considering the increading exploitation of the the industries worldwide, it is necessary to control the pollution made by them. Therefore, using different plants in industrial areas can help reduce the pollution made by industries, proving the grounds for effective biological management of the lands. Therefore, according to the results of this study, *L. depressum* plants are suitable for cleaning the soil of the industrial and other similar areas polluted by high concentraion of Ni.

Keywords: Accumulation Factor, FESEM and EDX Microscopes, Ni, Transfer Factor.