

APPLICATION OF PHYTOREMEDIATION FOR RECOVERY OF SALTED SOILS LOCATED NEAR COAL MINING PONDS

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The pond-storages of mine waters create a special danger for soil quality in the regions of coal mining. Their exploitation leads to the formation of sources of man-caused infiltration, which promotes the development of soil salinity processes and leads to changes in their physical and chemical properties. To restore salted lands, as well as to increase soil fertility, various methods of melioration have been analyzed, among which the most effective is their biological reclamation. Therefore, there is a need to find plants that are capable to efficiently and rapidly absorb salt from the soil, and also to increase the content of soil humus.

Preliminary selection of plants that could potentially be used in the climatic and edaphic conditions of the Western Donbas for desalinization of soils on the territory of coal-mining enterprises was carried out. The following plants were selected for phytoremediation: *Medicago sativa* L., *Onobrychis* spp., *Melilotus albus* and *Melilotus officinalis* (L.) Pall. To carry out the vegetation experiment, the soil samples were taken in the area adjacent to the pond storage of mine waters in the gully Svidovok (Western Donbass) at distances of 100, 500, 1000, 1500 and 2000 m in four cardinal geographic directions. The control soils were sampled on the territory of the Tsarichansk district in the Dnipropetrovsk region. The ability of plants to absorb salts from the soils was determined on the corresponding soil substrate, moisturized up to 70% where the seeds of the above-mentioned test cultures were sown. For the first few days the vessels with the samples under study were covered with glasses. Two to three times a day, the glasses were removed for 10-15 minutes of ventilation. On the fourth day, containers with planted seeds were placed in Phytotron, where they were kept for 14 hours under constant light and temperature 22–25°C. The experiment was carried out in six replicates for each species. Experiments are performed from April to September.

Analysis of the data revealed that due to cultivation of *M. sativa* on saline soils, the total salt concentration decreased by 4.4%. The maximum absorption was observed for SO_4^{2-} , and the sulfate content decreased from 2.7 to 2.0 mg eq / 100 g of soil. Absorption by *M. sativa* L was up to 35% of SO_4^{2-} and the increase in calcium content ranged from 1.03 to 1.21 mg eq / 100 g of soil (17.5%). The use of *Onobrychis* spp. reduced the salt content in the soil by 4.8%. The content of calcium and sulfates in the saline composition of the soil decreased on average by 10 and 25% respectively. Application of *M. albus* led to a decrease in the total salt concentration by 18.4%, which is quite a high value and indicates the effectiveness of the selected plant. Maximum absorption was observed with respect to $\text{Na}^+ + \text{K}^+$ and Ca^{2+} ions. The sulfate content was reduced by 80%. *M. officinalis* reduced the salt content in the soil to 5%. There was an increase in the calcium content in the saline composition of the soil, as well as high $\text{Na}^+ + \text{K}^+$ and sulfate uptake rates. The use of *M. albus* led to the maximum effect of salt reduction in the soil while the humus content was decreased. *M. officinalis*, on the contrary, with a slight dissolving effect demonstrated high levels of increase in the content of organic substances. Therefore, the use of the investigated plants may be advisable according to the scheme: 50% of *M. albus* seeds + 50% of *M. officinalis* seeds. Under this scheme, the sustainable result of phytoremediation can be expected on the third year of cultivation. At the same time, the humus content may increase almost twice (by 93%).

Thus, it is possible to predict the expected reduction of the total salt content in the soil up to 0.2 % when using both *M. sativa* and *Onobrychis* spp. The average period of reclamation using these plants, depending on the initial salinity levels on the studied territories, may be from 2 to 5 years. Application of the proposed plants can stabilize the qualitative and quantitative salt composition of soils, increase the content of humus, as well as reduce the pH of soils. The proposed schemes with the use of *M. albus* and *M. officinalis* (50% + 50%) for the restoration of disturbed lands allow not only to normalize the salinity of the soil in about 3 years but also to improve the soil fertility.

Key words: Mine Waters, Soil Salinity, Phytoremediation