СЕКЦІЯ 3
ЕКОЛОГІЧНА БЕЗПЕКА СІЛЬСЬКОГО ГОСПОДАРСТВА, ТЕРИТОРІЙ ТА АКВАТОРІЙ

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THE INFLUENCE OF PHYSICOCHEMICAL PARAMETERS ON GERMINATION RATES OF *HORDEUM MURINUM* AND *BROMUS JAPONICUS*

There are 1185 coal dumps in the Western Donbass. Coal dumps contain about 1.3 billion tons of rocks with an annual replenishment of about 60 million tons. The total coal production in 2020 was about 18.9 million tons. Coal dumps occupy large areas and need reclamation in the future. Phytoremediation is one of the best methods for reclamation of the coal dumps. Concerning phytoremediation of fresh coal heaps the use of pioneer plant species characterized by fast germination and fast development of a dense plant cover offers numerous benefits, including erosion stability of the heap, reduction of rainwater infiltration and removal of potential leaching of compounds into neighbouring water bodies.

The object of the study was a coal waste heap in the Western Donbass, Ukraine. Sampling for the study was performed on the basis at the mine "Heroiv Kosmosy", village Verbky, Ukraine. The samples were freshly extracted rock from the mine. Wall barley (*Hordeum murinum*) and Japanese brome (*Bromus japonicus*) were used as phytoindicators of the typical ruderal vegetation of the steppe region of Ukraine.

In the first step pH and electrical conductivity (EC) of the substrate were analysed. The pH of the substrate collected from the coal dump was 7.7, electrical conductivity was 1200 μS/cm. The total content of heavy metals, other potentially toxic elements in the substrate was determined by inductively coupled plasma mass spectrometry (ICP-MS). ICP-MS analysis of aqua regia dissolvable of trace elements in samples taken from the coal dump revealed that the concentration of all measured elements Co; A; Cu; Pb; Mn; Zn and Cr exceeds the maximum allowable concentration (MAC) in 59; 38; 47; 11.5; 2,5; 25 and 64 times respectively.

The first experiment investigated effects of substrate porosity on the germination rates. Six possible models, with different porosity of the substrate were analyzed: 1) 100% substrate from the coal dump ; 2) 80% of the substrate from the coal dump and 20% of sand; 3) 60% of the substrate from the coal dump and 40% of sand; 4) 40% of the substrate from the coal dump and 20% of sand; 5) 20% of the substrate of the coal dump and 80% of sand; 6) 100% sand. Both species were cultivated in a greenhouse. After 21 days of plant growth *H. murinum* developed 7 ± 1 cm roots, and average shoot size was 15 ± 1 cm. Biomass was 0.7 g for root and 0.8 g for shoot. In contrast, *B. japonicus* showed a root length of 4 ± 0.5 cm and shoots were 8 ± 0.5 cm tall. Biomass

was 0.6 g (root) and 0.7 g shoot (100% substrate from the coal dump). With increasing volume of sand in the pot, the length of the root and shoot of the plants increased on 5-10% respectively for both plants.

The second experiment investigated effects of substrate acidification on the plant growth parameters. The plants were watered with acidic treatment solutions at a pH range from pH 2–7. After 21 days of plant growth *H. murinum* developed 7 ± 2 cm roots, and average shoot size was 20 ± 1 cm tall. Biomass was 0.6 g (root) and 0.6 g shoot. In contrast, *B. japonicus* showed a root length 4 ± 0.5 cm and shoots were 8 ± 0.5 cm . Biomass was 0.6 g (root) and 0.5 g shoot (pH=2). In contrast, *H. murinum* developed 9 ± 2 cm roots, and average shoot size was 18 ± 1 cm tall. Biomass was 0.3 g (root) and 0.9 g shoot. In contrast, *B. japonicus* showed a root length 2 ± 0.5 cm and shoots were 10 ± 0.5 cm . Biomass was 0.4 g (root) and 0.8 g shoot (pH=7). The results, showed that plants are "tolerant for acidification of substrate".

The third experiment performed to determine the influence of heavy metals on the growth of *H.murinum* and *B.japonicus*. The plants were cultivated in greenhouse and watered with solutions with salts of heavy metals such as (Pb, As, Co, Cu, Mn and Zn) with different concentration that exceed the maximum allowable concentration (in 1 and 10 fold). After 21 days of plant growth *H. murinum* developed 13 ± 1 cm roots, and average shoot size was 15 ± 1 cm . Biomass was 0,7 g (root) and 1 g shoot. In contrast, *B. japonicus* showed a root length 5 ± 0.5 cm and shoots were 9 ± 0.5 cm tall. Biomass was 0,5 g (root) and 1.4 g shoot, when plants were watered solutions with concentration that exceed the maximum allowable concentration in 10 times. Thus, compared to control plants, biomass was reduced by 15 % and root and shoot length by 10% for both plants. It is concluded that plants are tolerant to heavy metals.

In conclusion, *H. murinum* and *B. japonicus* had good germination rates and can be good candidates for phytoremediation of coal dumps.

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