DOI: http://doi.org/10.21698/simi.2022.ab22

THE ASSESSMENT OF PHYTOTOXICITY OF SOIL CONTAMINATED WITH PERSISTENT ORGANIC POLLUTANTS

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Keywords*: phytoremediation, phytotoxicity, soil toxicity, persistent organic pollutants*

Introduction

Bioremediation involves the decomposition of pollutants into non-toxic forms for the environment, using the metabolic capacities of microorganisms. Practice shows that the successful implementation of bioremediation in the field usually involves the combination of several techniques to stimulate the capabilities of soil microbes. Phytoremediation is one of the widely used techniques, which consists of using plants to remove, extract, contain or immobilize contaminants. Recently, this technology is increasingly being implemented as an innovative, cost-effective and sustainable alternative to classical treatment methods. The efficiency of phytoremediation depends on the plant species chosen, the vital capacities of the plant, sufficient growth of shoots and root biomass, active proliferation of root system, which, in turn, will support a viable microbial consortium that promotes phytoremediation in the rhizosphere.

The present study was conducted to test the effect of soil polluted with various contaminants, collected from the territory of former pesticide storages, located in the Republic of Moldova, on oat and pumpkin seeds germination and roots growth.

Materials and methods

The samples of soil polluted by polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and organochlorine pesticides complex were collected from the territory of three former pesticide storages, located in the Dubasari district (DS 73, DS 80, DS 90) and one former pesticide storage, located near the village Slobozia-Dusca (SD-01), the Criuleni district, the Republic of Moldova. The sample of the reference soil (control soil) was taken near the Slobozia-Dusca former storage at a distance of 200 m from on the rising slope.

The grade of phytotoxicity of the polluted soil and reference soil was evaluated by the soil plate method, with the application of oat (*Avena sativa* L.) and pumpkin (*Cucurbita pepo* L.) seeds. The grade of soil toxicity was determined by the difference in the length of the roots between the experimental variants and the control (distilled water was used as the control) and was calculated according to the formula: $Gt = 100 – (Lx / Lm) \times 100$, where Gt – grade of soil toxicity; Lm – the length of the roots in the control variant; Lx – the length of the roots in the experimental version.

Results and conclusions

The reference soil was not toxic to the oat and pumpkin seeds; on the contrary, it favored their growth, on 37.5% and 33.3% correspondingly. Soil collected from the territory of former pesticide storages, located in the Dubasari district (DS 73, DS 80, DS 90) with a predominance of PAHs, PCBs, and hexachlorocyclohexane (HCH) did not show toxic effects on the growth of pumpkin roots. The roots of oat shoots were more sensible and the inhibitory effect appeared, the grade of soil toxicity was between 29-33% for soil from Dubasari district, where the total sum of pollution was 0.03-1.75 mg/kg dry soil (Table 1).

Table 1. The phytotoxic effect of polluted soil on oat seeds

Nr	Variant	Pollution, mg/kg dry soil	Roots length, mm	Grade of toxicity, %
Control	H_2O	-	103.33 ± 16.93	-
1	Reference soil	-	142.11 ± 21.81	-37.53
2	DS 73	0.03	70.13 ± 13.08	32.14
3	DS 80	0.05	68.67 ± 15.01	33.55
4	DS 90	5.31	50.35 ± 14.65	51.27
5	SD-01	250.0	7.61 ± 1.59	92.63

The most toxic effect – 92.6% had the soil that was collected from the territory of former pesticide storage, located near the village of Slobozia-Dușca, the Criuleni district. In previous study 10 POPs substances were determined in the soil in concentrations corresponding to the high level of contamination. In addition to HCH, dichlorodiphenyltrichloroethane (DDT) and their metabolites, traces of other pollutants have been recorded, such as heptachlor, gamma-chlordane, alfa-chlordane, endosulfan sulfate, toxaphene, trifluralin and atrazine (Rastimesina et al., 2021). High doses of these obsolete pesticides can inhibit the vital functions of seeds, and lead to a reduction of root system, which will hinder soil phytoremediation and require prior bioremediation measures.

Acknowledgments. This work was funded by NARD of the Republic of Moldova within State Program Project 20.80009.7007.20 "Study and management of pollution source for the elaboration of recommendations for implementing to reduce the negative impact on the environment and population health."