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MICROBIOLOGICAL ASSESSMENT OF PESTICIDES CONTAMINATED SOIL AFTER BIO- AND PHYTOREMEDIATION

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Introduction

Xenobiotic compounds have been used extensively worldwide in agriculture as herbicides and insecticides and in the manufacturing industry as solvents and degreasers. The quantities of fertilizers and pesticides used in Republic of Moldova were significantly reduced recently, and there is no current problem of pollution with nitrates and heavy metals. Nevertheless, the problem of local pollution of soils with different wastes and harmful substances continues to be acute. A large number of locations are contaminated with several POPs compounds, which raises the question of potential synergistic effects of impact on the population and the environment. In most cases, the mixture of detected pollutants includes DDT metabolites, isomers of HCH and toxaphene.

Destroyed storehouse for pesticides and organic fertilizers located near Sangera village, Chisinau municipality, Republic of Moldova, has been selected using Management of Persistent Organic Pollutants (*http://pops.mediu.gov.md/*). The site was long-term and complex polluted by pesticides, the total content of which was 21.5 mg/kg dry soil; the major component of contamination was dinitroaniline herbicide trifluralin and the minor component was DDTs – organochlorine insecticide DDT and its metabolites DDE and DDD considering our previous studies. Both compounds are classified as halogenated organic pesticides, but the approaches used for bioremediation of contaminated soil have different effects on their transformation.

The aim of our research was to assess the effect of bio- and phytoremediation procedures on soil contaminated with halogenated organic pesticides, DDTs and trifluralin.

Materials and methods

The experiment on soil bioremediation *ex situ* was established in the dark plastic jars, each containing 1,000 g of polluted soil. Contaminated soil without remediation was used as a control. The experiment was designed in oxic, anoxic and cycled anoxic / oxic conditions. At the set up of the experiment in oxic conditions, the soil was amended with water, 60% of water-holding capacity (WHC). The duration of experiment was 112 days.

Anaerobic conditions were created by saturating the contaminated soil with water, 80% of WHC, in the plastic jars sealed with Parafilm, and stored in the dark at 22-24°C. At the beginning of the aerobic phase, lasted for 7 days, Parafilm has been removed, and soil moisture was gradually brought up to 60% of WHC. The anoxic and cycled anoxic / oxic conditions continued for 63 days, then it was passing to the aerobic phase by applying sawdust, and phytoremediation with alfalfa *Medicago sativa* L. and oat *Avena sativa L*., for 72 days. Monthly plants were cut, mixed with the soil and new seeds were planted.
At the end of the experiment, the systematic groups of microorganisms (micromycetes, bacteria, actinomycetes) present in the soil were observed through inoculations on solid selective media.

Results and conclusions
The assessment of microbiological activity of the soil after the procedures of bio- and phytoremediation concerned at studying the indigenous soil microflora, which is involved in nitrogen transformation processes, and survived the conditions of prolonged toxic stress.
Under the long-term influence of toxicants there was a restructuring of soil microbial cenosis in the direction of reducing microbial diversity, but with the emergence of more resistant species. In the control, naturally attenuated, the number of bacteria and micromycetes was much smaller and represented by microorganisms that adapted to the action of halogenated organic pesticides. The bioremediation procedures, in most cases, considerably facilitated the activation of the soil microbiota. In experimental options, maintained in aerobic conditions using alfalfa and oat as phytoremediation plants, significant stimulation of bacterial growth was observed.
In the experimental variants, maintained in anoxic and cycled anoxic / oxic conditions followed with phytoremediation, the number of microorganisms was tens and hundreds of times higher than in the control. The formation of a larger pool of microorganisms indicates the recovery of the soil.

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