99c Monitoring of Pesticide Polluted Areas and Approaches to Bioremidiation of Territories

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After effects of multi-year storage and burial of highly toxic preparations have become an urgent ecological issue for many regions of Russia. At the moment, Russia and CIS countries stock about 500-600 thousand tons of pesticides to be destroyed. Without a doubt, this is a vital issue. For instance, in the Kirov region there are tens of former storage facilities and burials (Pic. 1). The largest is Kilmez agricultural pesticide burial storage. Over 6,000 tons of pesticides containing chlorine, phosphor, arsenic and mercury with expired shell-life have been disposed there. According to the monitoring data, in wells situated near the burial such chemicals as the pesticide sodium trichloroacetate (up to 10 MPC), 2,4-Д-amine salt, hexachloran (up to 5 MPC), and mercury-containing pesticides (400 MPC) can be found. The pesticide Hexachlorocyclohexane (2 MPC) was found in the soil. Lichenoid identification data highlights bad air condition around the burial: this was shown by a sharp decrease in lichen quantity and diversity (from 35 to 2 species). At the moment there are several unanswered questions, including: what the area of the polluted zones is; how dangerous they can be in the future, and how the pesticides will change chemically over time. A pilot monitoring program for these agents has been developed. It also includes approaches to bioremediation of pesticide polluted impact zones. The program includes evaluation of xenobiotic soil pollution around the territories of pesticide storage and disposal, and isolation and laboratory scale growth of those autochthon strains. These strains function as xenobiotic destructors and help to remediate territories biologically. The program presupposes that a complex survey of soil and water pollution levels is to be performed around the territories where pesticides are stored and disposed. This survey makes it possible to determine basic monitoring aspects specific for each particular zone: parametric (list of substances to be monitored, describing the hazard class), chorologic (determination regarding barrier landscape characteristics of those places where pollutant are to be deposited in soil and local water sources, setting up sampling sites and hydrologic stations), chronological , etc. In order to remediate soil at the polluted area, a complex microbiological study of soil samples is scheduled, including the following items: setting up typology of polluted areas (including vertical); selection of test sites based on geochemical pollution area surveys; determination of primary environment-forming biotope components (phase, type of soil and vertical parameters of soil profile, main geochemical barriers, water nutrition, geomorphology, etc.); and the determination of species composition of microbial cenosis for given biotopic conditions. For test sites – key (impact zones) and control sites, the following tasks will be carried out: isolating the destructive active components in pesticides, performing species identification of the microorganisms (prokaryote and eukaryote), determining the percentage of biomass species density as well as ultimate density of microbial biomass, and determining the biomass species dependence on the range of influence of certain eco-toxicants. The obtained data reveals to what extent pesticides influence the local saprophytic microflora. This data gives justification to conduct further selection of species and isolation of pure strains possessing maximal destructive capability. After this is performed, studies of biomass cultivation procedure and process scaling will be carried out, operational procedures for microbial pesticide destructive biomass cultivation in the laboratory will be developed, and modes of pesticide destruction by microorganisms will be worked out. However, the task of microbiological remediation of soils is challenged by the presence of vertical stratification in topical conditions of microbial cenosis development. All the present vertical differences in primary factors of habitat – temperature, humidity, aeration degree, soil composition, and plant root layer cenosis, determine the variability of microbial spices structure, including xeobiotic destructors. Therefore, it is extremely difficult to pick out the set of the most efficacious strains for bioremediation. Thus, to narrow the range of tasks, special emphasis was given to those landscape components which, from the one side, are depressive, and, on the other, possess maximal accumulative characteristics – geochemical barriers of different nature. Thus, for instance, in the typical situation described above, pesticide disposals are found at the orographically heterogeneous sub-flood plain of river ecosystem. Here there is no need to conduct a complex microbiological study of

soil samples taken from landscape transitive components, confined to available depressions in local accumulation. In addition, it is evident that alluvial soil level can be also eliminated, taking into account that over the course of time, all the pollutants have already been washed out. Therefore, the biotope of the geochemical barrier and those of the alluvial soil level are to become the key objects of studies in the view of vertical stratification. Thus, the conditions that lead to microbial contamination at the determined test site will be significantly lessened. Program implementation will highlight directions of prospective scientific investigations on bioremediation of pesticide polluted impact zones.

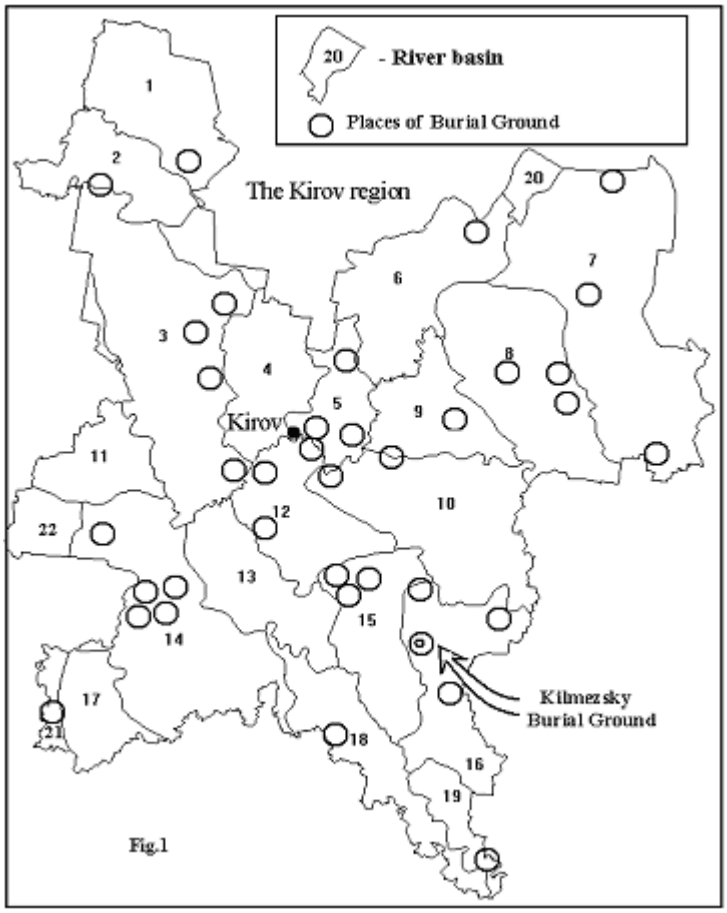

Fig.1