542e Phytoremediation of Energetic Materials (Dnts and Rdx) Using Arabidopsis Thaliana

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2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) were commonly found as surface soil and groundwater contaminants at military testing and training sites. Phytoremediation is a promising technology due to sustainability, low operating and maintenance costs, and esthetic standpoints. Feasibility of phytoremediation of the energetic materials was tested by using a model plant, Arabidopsis thaliana.

The toxicity of energetic compounds to the various organisms has been studied, but the toxicity to plants is not well known. For the toxicity tests, 5-day-old wild-type Arabidopsis seedlings were transferred to a half-strength of Murashige and Skoog (MS) media containing different concentrations of energetic materials. The dry biomass of plants exposed to 10 mg/L of 2,4-DNT was half of that of control (without 2,4-DNT) after 7 days. 2,6-DNT was less toxic than 2,4-DNT. RDX was not toxic up to its solubility limit by comparing the dry biomass between exposed plants and unexposed plants. For an alternative of the toxicity tests, root growth assays were conducted. The root growth of the plants exposed to DNTs was stunted. The root growth assay was more sensitive than the biomass assay.

From the uptake study, DNTs were taken up by plant faster than RDX. About 95 % of the initial DNT radioactivity after 10 days was removed from liquid media. In the case of RDX, Arabidopsis removes 59% of the initial radioactivity of 14C-RDX from the media after 35 days. In controls, 19% of the 14C-RDX was removed due to photolysis, binding to plant matter, and chemical instability.

RDX was transformed and mineralized by the plants. Significant portion of the initial radioactivity (10 %) was recovered as CO2 by the live plants compared to controls with autoclaved plants and controls with no plants (less than 1%) after 35 days exposures. However, the mineralization of DNTs was not significant (less than 1 %).

This research was supported by the U.S. Department of Defense, through the Strategic Environmental Research and Development Program (SERDP), Project CU-1319.