Plant Processes Important for the Transformation and Degradation of Explosives Contaminants

Elly P. H. Best[a,*], G. Kvesitadze[b], G. Khatisashvili[b], and T. Sadunishvili[b]

[a] U.S. Army Engineer Research and Development Center, Environmental Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180, USA. Fax: 1 601 634 4002. E-mail: beste@wes.army.mil

[b] Durmishidze Institute of Plant Biochemistry, Academy of Sciences of Georgia, 0159 Tbilisi, Georgia

* Author for correspondence and reprint requests

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Environmental contamination by explosives is a worldwide problem. Of the 20 energetic compounds, 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) are the most powerful and commonly used. Nitroamines are toxic and considered as possible carcinogens. The toxicity and persistence of nitroamines requires that their fate in the environment be understood and that contaminated soil and groundwater be remediated.

This study, written as a minireview, provides further insights for plant processes important for the transformation and degradation of explosives. Plants metabolize TNT and the distribution of the transformation products, conjugates, and bound residues appears to be consistent with the green liver model concept. Metabolism of TNT in plants occurs by reduction as well as by oxidation. Reduction probably plays an important role in the tolerance of plants towards TNT, and, therefore a high nitroreductase capacity may serve as a biochemical criterion for the selection of plant species to remediate TNT. Because the activities and the inducibilities of the oxidative enzymes are far lower than of nitroreductase, reducing processes may predominate. However, oxidation may initiate the route to conjugation and sequestration leading ultimately to detoxification of TNT, and, therefore, particularly the oxidative pathway deserves more study. It is possible that plants metabolize RDX also according to the green liver concept. In the case of plant metabolism of HMX, a conclusion regarding compliance with the green liver concept was not reached due to the limited number of available data.

Key words: Explosives, Transformation, Phytoremediation