# Aerobic Bioremediation Processes that Degrade TNT Contaminants in Soil

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### Abstract

TNT is a chemical that is widely used in ammunition, bombs, and other explosive weaponry. When detonation of the aforementioned explosives and weapons occurs there is a TNT residue that is left over. This residue creates an environmental hazard that affects bacteria, plant, and animal growth and survival. The TNT residue can also enter into the water supply and contaminate animal and human drinking water. Because of the toxic effects TNT residues could possibly invoke in the environment, the United States government has been performing research on cleaning up TNT contaminated areas. Aerobic strategies that show the ability to degrade TNT include using transgenic tobacco plants, white rot fungi, and composting to degrade the TNT residues in these contaminated environments.

### Keywords

2,4,6-trinitrotoluene (TNT), phytotoxic, phytoremediation, nitroreductase

## Introduction

2,4,6-trinitrotoluene (TNT) is prevalent in a large proportion of the soil surrounding military firing ranges throughout the world. TNT is one of the most highly toxic and recalcitrant explosives. The presence of TNT is hazardous because it presents a risk of detonation, is extremely toxic to humans, may enter the water supply, and may prevent the growth of vegetation in affected areas, upsetting the balance of the ecosystem (Boyd and Bruce, 2002). Present strategies of getting rid of TNT include burning, detonation, and burial of the toxic material. These methods create a large amount of useless ash and present serious problems for the atmosphere due to associated release of other toxic chemicals in the soil and the water supply.

The manufacturing, detonation, and disposal of explosives over the last hundred years has resulted in serious widespread contamination of the environment. Apart from the possible hazard of detonation, the continuing accumulation of explosive residues over the years resulted in the environment becoming contaminated and in some cases unstable for biological systems.

Large areas of land remain contaminated and continue to be polluted worldwide, and such demanding and expensive remediation procedures are clearly not an option for developing countries. The lack of affordable and effective cleanup approaches therefore demands the development of novel remediation processes. Recent attention has focused on phytoremediation, which is the use of plants to remediate environmental toxicity, fungus, which use white rot fungi to degrade TNT, and composting.

### **Transgenic Plants Expressing Nitroreductase Gene**

Plants are very diverse and adapt their traits in order to survive in a wide variety of stressful environments such as areas of high salinity, extreme heat, drought, and freezing temperatures. By using genetic modification on plants, scientists have been able to expand the role plants play in the environment. With the use of transgenic biotechnology, plants can be enhanced with qualities that not only allow them to thrive in stressed environments but also allow them to be used in the effort to alleviate environmental stresses.

To overcome the high phytotoxic or poisonous effects TNT has on tobacco plants, scientists introduced bacterial nitroreductase into the genome of these tobacco plants. The tobacco plant was chosen because it is well suited to quickly express genes and have the benefits of these