High concentrations of 2,4-dinitrotoluene (2,4-DNT) and 2,6-dinitrotoluene (2,6-DNT) are present in vadose zone soils at many facilities where explosives manufacturing has taken place. Both DNT isomers can be biodegraded under aerobic conditions, but rates of intrinsic biodegradation observed in vadose zone soils are not appreciable. Studies presented herein demonstrate that nutrient limitations control the onset of rapid 2,4-DNT biodegradation in such soils. In column studies conducted at field capacity, high levels of 2,4-DNT biodegradation were rapidly stimulated by the addition of a complete mineral medium but not by bicarbonate-buffered distilled deionized water or by phosphate-amended tap water. Biodegradation of 2,6-DNT was not observed under any conditions. Microcosm studies using a DNT-degrading culture from column effluent suggest that, after the onset of 2,4-DNT degradation, nitrite evolution will eventually control the extent of degradation achieved by two mechanisms. First, high levels of nitrite (40 mM) were found to strongly inhibit 2,4-DNT degradation. Second, nitrite production reduces the solution pH, and at pH levels below 6.0, 2,4-DNT degradation slows rapidly. Under conditions evaluated in laboratory-scale studies, 2,4-DNT biodegradation enhanced the rate of contaminant loss from the vadose zone by a factor of 10 when compared to the washout due to leaching.