The fate of the three herbicides 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), atrazine (6-chloro-N-ethyl-N'-[1-methyl-ethyl]-1,3,5-triazine-2,4-diamine), and DNOC (4,6-dinitro-2-methylphenol) in an anaerobic sandy aquifer was investigated. In the field, each of the herbicides was released simultaneously with tritiated water (HTO) as tracer in the depth interval 3 to 4 rubs (meters below surface) by use of passive diffusive emitters. Atrazine and 2,4,5-T were persistent during the approximately 18 days residence time in the aquifer. In contrast, DNOC was rapidly removed from the water phase following first-order kinetics. The removal mechanism was likely an abiotic reduction. At day 25, the first-order rate constant was 1.47 d\(^{-1}\), but it decreased with time and seemed to stabilize at 0.35 d\(^{-1}\) after 150 to 200 days. In the laboratory, batch experiments were conducted with sediments from 3 to 4 rubs and from 8 to 9 rubs. In these incubations, formation of Fe\(^{2+}\) and depletion of sulfate showed iron and sulfate reduction in sediment from 3 to 3.5 rubs and sulfate reduction in 3.5 to 4 rubs sediment. In sediment from 8 to 9 rubs, the dominant redox process was methane formation. In sediment from 3 to 3.5 rubs, only 27% to 52% of the 2,4,5-T remained after 196 days. 2,4,5-trichlorophenol was identified as the major metabolite. A lag period of at least 50 days was observed, and no degradation occurred in HgCl\(_2\) amended controls, verifying that the process was microbially mediated. In the other 2,4,5-T incubations and all the atrazine incubations, concentrations decreased linearly, but less than 25% was removed within 200 to 250 days. No degradation products could be detected, and slow sorption was the likely explanation. In all the laboratory incubations DNOC was degraded, following first-order kinetics, and when normalized to the sediment/water-ratio, the field and laboratory derived rate constants compared well. The DNOC degradation in the methanogenic incubations (8 to 9 rubs) was up to 50 times faster than in the sediments from 3 to 4 rubs, likely due to the low redox potential.