BACTERIAL OXIDATION OF METHYL BROMIDE: FIELD TESTS

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Use of methyl bromide (MeBr) as a soil fumigant is currently restricted. Its future use is likely to be severely constrained or banned. The U.S. Clean Air Act and the Montreal Protocol now call for a phased reduction of MeBr emissions that will result in a 100% reduction by 2005. The term "emissions" is critical because to date no reasonable alternatives to MeBr have been developed. Therefore, a remediation technology which eliminates MeBr emissions from fumigated fields would allow for its continued employment in the USA until 2005, and if effective, possibly thereafter. We have isolated a bacterium, strain IMB-1, which grows on MeBr and have found ways to achieve its mass culture with high MeBr oxidation activity (Miller et al., 1997; Connell-Hancock, et al., 1998). We previously reported the results of experiments with small mesocosm soil enclosures and demonstrated that addition of cell suspensions of strain IMB-1 to soils results in significant destruction of MeBr (Miller, et al., 1998). This strategy was the foundation of a bioremediation project that is currently underway. We have extended the mesocosm experiments to field studies at the Bay Area Research and Extension Center in Santa Clara, California. Mineralization of MeBr was determined by the production of bromide (Br^-) in soil below flux chambers. Results of short (1-day) incubations showed that some mineralization of MeBr occurred in control chambers without cells (phosphate buffer only), presumably as a result of chemical hydrolysis. By contrast, a greater amount of mineralization (2-3 x the controls) occurred in chambers with added IMB-1 cells where both hydrolysis and biological oxidation occurred. An approximate mass balance was achieved where the amount of MeBr injected below the chambers could be accounted for by the sum of MeBr flux across the soil-air interface and MeBr mineralization within the soil. Additional long-term field tests were conducted with MeBr injected below high density polyethylene (HDPE) film to determine the sustainablity of bacterial activity over 4-5 days in a scenario that more closely resembled field fumigations. In the tarped experiments, the efficiency of strain IMB-1 to act as a bacterial barrier to MeBr emission was evaluated by measuring the flux of MeBr through the tarps in plots with and without added cells. Questions remain as to the optimal application rate of cells and the effect of various concentrations of chloropicrin on the bacterial oxidation of MeBr. We next plan large (field) scale experiments where strain IMB-1 will be applied directly by the tractor during the fumigation procedure.

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