

Modeling Ground Water Contamination by Soil Fumigants in Hawaii and California: Soil Loading and Fate Input are Critical for Validated Predictions

Crop-destroying nematodes have been controlled with soil fumigants, including those with the active ingredient 1,2-dibromo-3-chloropropane (DBCP) and the impurity 1,2,3-trichloropropane (TCP). These products are injected into the root zone of plants prior to planting. Ground water was contaminated with DBCP and TCP following application to pineapple fields on Maui, and TCP was found in ground water in southern California following many years of application to four other crops. Two independent teams modeled the front end – pesticide application and movement through the root zone – and the saturated zone, without review of monitoring results, in a ‘double blind’ approach. More than 20 yrs each of daily weather records, pesticide application histories, and irrigation practices had to be constructed for the two sites. There was good documentation at the pineapple plantation, although some estimates/interpolation about irrigation and rainfall had to be made. The forensic investigation of the southern California site was more challenging, and it integrated evaluations of historic aerial photographs, farmer interviews, site visits, and research of old Extension documents. Soils at both sites were sampled and analyzed to obtain relevant modeling parameters. Site-specific environmental chemistry parameters were derived, focusing on hydrolysis and transport parameters. Root zone contaminant flux was modeled with the EPA’s Pesticide Root Zone Model (PRZM), and HYDRUS-1D was used below the root zone, which fed into saturated zone modeling using MODFLOW-2000 and MT3D. Minimal model calibration was needed to obtain excellent agreement between predicted and at least 10 years of observed concentrations for both locations. This good agreement could only have happened if the decades of front-end loading parameters had been developed correctly. The models were used to predict future contamination.

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