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Transport of selected pesticides in Oxisols: Results from laboratory column experiments

M. Snehota (1), C. Ray (2), J. Lichwa (2) and M. Sobotkova (1)

(1) CTU in Prague, Faculty of Civil Engineering, Prague, Czech Republic, (2) Water Resources Research Center, University of Hawaii at Manoa, Honolulu, HI, USA, (michal.snehota@fsv.cvut.cz / Fax: +420-233337005)

Past occurrences of ground water contamination from nematicides (used for pineapple cultivation) and herbicides (used for sugar production) in Hawaii has focused on a progressive approach to pesticide registration in Hawaii.

Current study is part of an extensive project at the University of Hawaii, where field and laboratory measurements were combined to evaluate leaching of selected newly registered pesticides in the vadose zone. Three herbicides, one fungicide and one insecticide were the new commercial products entering the market in Hawaii. In addition, herbicide atrazine and bromide ions were used as two reference chemicals in the column leaching study.

Undisturbed soil monoliths were collected in Poamoho experimental site (Oahu, Hawaii). Soil cores were taken by inserting a stainless steel cylinder into soil using a hydraulic jack. Soil cores were equipped with three microtensiometers inserted at different heights. Infiltration-outflow and evaporation experiments were performed on each soil core. Cumulative infiltration and outflow, weight of the sample, and soil-water pressures were continuously monitored. Soil hydraulic properties were estimated from measured data by means of inverse modeling. The solute displacement experiments were conducted on the same soil cores. The near-saturated flow was secured by maintaining small tension at the bottom end of the column while constant water flux was applied at the top surface. Initially inflow rate was adjusted to achieve uniform vertical distribution of suction pressure head. After steady flow rate was achieved, the input was switched from water to an aqueous solution of pesticides and bromide and the same constant flow rate was maintained. The effluent was regularly collected and

analyzed for the presence of pesticides and tracer. The flow interruption technique was used to test the presence of non-equilibrium transport of pesticides in soil under study. Three-dimensional images were taken by means of computed tomography (CAT) to identify the structure of soil monoliths.

The results show fastest breakthrough for atrazine. Concentration of all chemicals equilibrated at input level after infiltration of approximately 5 pore volumes of solution. Bromide appeared not to behave as non-adsorbing tracer in the soil under study. Short flow interruption caused small decrease of concentration of three pesticides in effluent. This may signify the presence of non-equilibrium sorption. Together with the results of field measurements and independently measured sorption properties, the data provide a basis for prediction of leaching of the studied chemicals in the tropical environment.