

Modeling of Soil Moisture Flow and Nitrate Movement using mobile-immobile approach in Soil column experiment

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Nitrate (NO_3^-) is known as one of the potential groundwater contaminants especially in areas exposed to high fertilizer input because of agricultural activity. The vadose zone is the pathway for contaminants into the groundwater, understanding the transport mechanism of nitrate in different soil types is required to generate information to prevent groundwater pollution. In this study we investigate the behavior of soil moisture flow and nitrate transport through mobile-immobile (MIM) soil column based on the laboratory experiment. We hypothesize that porous media heterogeneity due to micro and macro pores causes saturation variability that leads to preferential flow systems such that a significant portion of the porous media does not significantly contribute to flow. The experimental soil column, made up of acrylic pipe having dimensions 120 cm length and 15 cm inner diameter with 25 sampling port at different vertical locations. A constant flux of 150 mL/hr having 100 ppm nitrate concentration was allowed to flow in vertical direction. The study considers Richards equation and advective-dispersive transport equation to simulate moisture flow and nitrate transport in soil column experiment. Afterward, the numerical model HYDRUS 1D was run with single porosity, dual porosity (mobile immobile) approach to simulate experimental breakthrough curves (BTCs) for transport of Nitrate through homogeneous variably saturated soil column. It was found that the dual porosity (mobile-immobile) approach simulate experimental BTCs reasonably well as compared to the single porosity model. The findings of this study may be helpful to better predict fertilizer retention times in vadose zone, prior to recharge into underlying water resource system.

Keywords: Nitrate Transport, Soil Column, HYDRUS -1D, Breakthrough curves (BTCs)