Simulation of Water and Nitrate Transport in Soil Using HYDRUS-1D Model in Furrow Irrigation of Sugarcane

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Abstract

Simulation of water and solute transport in soil is very useful for optimum management of water and fertilizer use. In this study, the HYDRUS-1D model was used to simulate water and nitrate transport in furrow irrigation of sugarcane. For this putpose, a large-scale experiment was performed as a split plot design based on the randomized complete blocks with 3 replications in a 25-hectare piece of land in the Dehkhoda Sugarcane Agro-Industry Company from March 2012 to October 2013. The main factor was split application of fertilizer at three levels: two, three and four splits. The sub-main factor was fertilizer amount, applied at three levels (i.e. 350, 280 and 210 kg urea corresponding to 100%, 80% and 60% fertilizer requirements, respectively). Soil hydraulic parameters were estimated through inverse modeling using moisture data collected during more than 4 months of the sugarcane growing season. Solute transport parameters were then estimated using the hydraulic parameters and nitrate concentration data. In this study, statistical criteria including R^2, RMSE, ME and SSQ were used to compare the observed and simulated values of moisture content and nitrate concentration. The results indicated that R^2 for simulated moisture content and nitrate concentration in four splits and 60% fertilizer requirement treatment (i.e. calibrated treatment) were 62.7 and 91.2 percent, respectively. Cumulative infiltration depths were about 46 and 58 mm for calibration and validation treatments, respectively. For these treatments, the cumulative evapotranspiration rates were 50 and 60 mm, respectively. Soil moisture content in the surface layer varied from 21 to 45 and 21 to 42 percent, for calibration and validation treatments, respectively while the changes in the deep layer moisture content were 33 to 38 percent, for both treatments.

Keywords: Hydraulic parameters, Inverse modeling, Infliltration, Solute transport.

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