Modeling Nitrate Leaching from a Potato Field Using Adaptive Network-Based Fuzzy Inference System Combined With Genetic Algorithm

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Abstract

The conventional application of nitrogen fertilizers via irrigation is likely to be responsible for the increased nitrate concentration in groundwater of areas dominated by irrigated agriculture. This requires appropriate water and nutrient management to minimize groundwater pollution and to maximize nutrient use efficiency and production. To fulfill these requirements, drip fertigation is an important alternative. Design and operation of drip fertigation system requires understanding of nutrient leaching behavior in cases of shallow rooted crops such as potatoes, which cannot extract nutrient from lower soil depth. This study deals with neuro-fuzzy modeling of nitrate leaching from a potato field under a drip fertigation system. In the first part of the study, a two-dimensional solute transport model (HYDRUS-2D) was used to simulate nitrate leaching from a sandy soil with varying emitter discharge rates and various amounts of fertilizer. The results from the modeling were used to train and validate an adaptive network-based fuzzy inference system (ANFIS) in order to estimate nitrate leaching. Radii of clusters in ANFIS were tuned and optimized by genetic algorithm. Relative mean absolute error percentage (RMAEP) and correlation coefficient (R) between measured and obtained data from HYDRUS were 0.64 and 0.99, respectively. Results showed that ANFIS can accurately predict nitrate leaching in soil. The proposed methodology can be used to reduce the effect of uncertainties in relation to field data.

Keywords: Drip fertigation; ANFIS; HYDRUS-2D; Genetic algorithm; Nitrate leaching.

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