Evaluation of Artificial Neural Network for Estimating the Advance Velocity of the Wetting Front in Drip Irrigation

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Abstract

One of the most important parameters in designing, managing, and operating surface and subsurface drip irrigation systems is the advance velocity of the wetting (moisture) front in soil, which enormously affects the performance of these systems. Emitter discharge, soil type (soil texture and structure) and initial moisture content are the main factors affecting advance velocity under drip irrigation. Experiments were carried out in a transparent plexiglass tank (0.5 m*1.22 m*3 m) using three different soil textures (light, heavy, and medium). The drippers were installed at 4 different soil depths (surface, 15 cm, 30 cm, and 45 cm). The emitter outflows were considered 2.4, 4, and 6 L/hr. A simulation model was developed using artificial neural network (ANN) for predicting advance velocity of the wetting front (horizontal, downward, and upward direction) under point sources in surface and subsurface drip irrigation. The variables affecting wetting pattern included emitter discharge, emitter installation depth, application time, saturated hydraulic conductivity, soil bulk density, initial soil moisture content, and the proportions of sand, silt and clay in the soil. The results of the comparisons between the simulated and measured values showed that the ANN model was capable of predicting the advance velocity of the wetting front in different directions with high accuracy. The values of Root Mean Square Error (RMSE) varied from 0.09 to 0.35, from 0.02 to 0.17, and from 0.08 to 0.25 cm/min for horizontal, downward and upward velocity, respectively. Also, the values of Mean Absolute Error (MAE) varied from 0.06 to 0.27, from 0.02 to 0.07, and from 0.05 to 0.12 cm/min for horizontal, downward, and upward velocity, respectively. Using these models in designing and operating surface and subsurface drip irrigation systems could improve system performance.

Keywords: Irrigation management, Simulation, subsurface drip irrigation

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