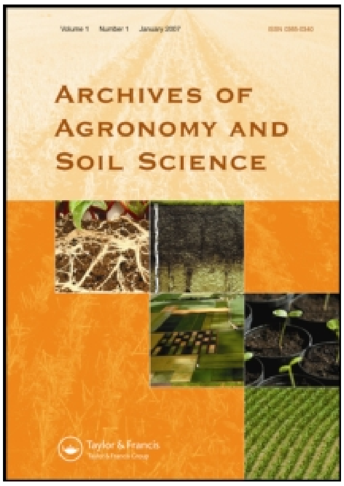

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Prediction of soil hydraulic parameters by inverse method using genetic algorithm optimization under field conditions

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In this study, soil hydraulic parameters were estimated by the inverse method in field conditions. At basins of 2 × 2 m, soil water content reached near saturation point up to about 1 m depth. Afterwards, the surfaces of the plots were covered by plastic sheets and the soil water content and pressure head were measured daily by TDR (time-domain reflectrometry) and ceramic tensiometers at different soil depths up to seven or 10 days later. The amounts of soil water content and pressure head were predicted in a profile by solving Richards' equation, applying the finite difference method. The values of soil hydraulic parameters [the parameters of soil water characteristic curve and matched saturated hydraulic conductivity (K_o)] were estimated by inverse method in which minimization of errors at different depths and times after wetting was obtained using genetic algorithm (GA). For prediction of soil hydraulic parameters, the ESHPIM2 model was developed based on the linkage of Richards' equation and GA method. The results showed that using the ESHPIM2 model was favorable. Because the effects of macropores in the movement of water under the inverse method were not taken into consideration, the predicted values of K_o were much lower than those measured by saturated hydraulic conductivity in field conditions.

Keywords: soil hydraulic parameters; Richards' equation; soil water content inverse method; genetic algorithm

Introduction

Water and solute transported in the vadose zone greatly depend on the physical and chemical properties of soil, which generally exhibits high spatial variability. Additionally, the experimental determination of those properties in the field or laboratory is tedious, time-consuming and involves considerable uncertainties for most practical applications (Ritter et al. 2003).

Some of these parameters can be measured directly in the laboratory (Alrousan et al. 2003). Furthermore, direct methods for determination of soil hydraulic parameters require the experiments to reach several stages of steady-state conditions and restrictive initial and boundary conditions as well (van Dam et al. 1990). To overcome these problems, indirect methods such as the inverse method can be used to estimate the basic soil hydraulic parameters. This procedure has the advantage that the results are based on variables, which are observed at a large time-scale under natural boundary conditions (Ritter et al. 2003).

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