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M.A. Thesis in Irrigation and Drainage Engineering)

Title:

Determination of Phillip infiltration equation parameters in surface irrigation

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Abstract:

Surface irrigation methods are one of the most common methods for using water in agricultural fields. In this method, infiltration is one of the most important parameters and therefore its measurement and determination is very important. The governing equations of infiltration are the continuity and momentum equations, known as the Saint-Venant equations, and are derived from momentum and the law of mass survival equations. Many researches have been done to calculate and predict the amount of water infiltration in the soil by various analytical (Philip), physical (Green-Ampt) and experimental methods (Kostiakov, Kostiakov-Lewis, Horton, etc.) which lead to many mathematical equations to quantitative description of the flow in a porous medium. Also, the methods such as double ring method are used to estimate the characteristics of water infiltration in the soil, which is a point method and cannot express the effect of dynamic conditions of water infiltration and cannot be generalized to real conditions. Therefore, to estimate the infiltration parameters, should be corrected the results of such measurements or the progress data and should be used other irrigation steps to estimate the infiltration characteristics. In estimating the infiltration parameters, so far, the three-part Phillip infiltration equation has not been used to determine the infiltration rate in surface irrigation. Also the volumetric balance model has not been presented in the Ebrahimian et al. two-point method. Therefore, for the purposes of this study, the three-part equation parameters of Philip's infiltration method were determined and optimized using the IPARM model method, and the volumetric balance model is presented for the two-point method of Ebrahimian et al. also, the one-point methods of Shepard et al. (1993) and Ebrahimian et al. (2010) were modified. A new two-point method was proposed and used to estimate the parameters of the two-part Philip influence equation. The volume balance equation was obtained for the two and three-part Philip equations. For mention purposes, optimization was required that using the INFILT optimization method based on the technique introduced by Climont and Smith (1996). Then, the optimization program code was written in Matlab software. From Benson irrigation data for clay loam soil, irrigation data set in sandy loam soil, Cuban irrigation data on cracked clay soil, Downs data in ordinary cracked clay soil, Merongel Hill data and Merkel irrigation data were used in this study. used standard error squares (SSE), root mean square error (RMSE), detection coefficient (R2) and MBE index to statistical analysis.

The results showed that the use of coefficients obtained from the Ebrahimian method in the volume balance equation calculated, significantly improved the prognosis error rate. Also, using instantaneous flow data instead of average flow rate has reduced the forward error rate. The results of the modified two-point method were better for farms with less discharge changes than other methods. The results of the three-component Philippe equation were better for farms with variable flow rates. According to the mentioned results, the parameters of Philip equation were optimized by Infilit program.

Keywords: Infiltration, Volume Balance Method, Surface Irrigation, Two-Point Method, Philip Equation.