Application and Comparison of Particle-Size Distribution Models to Estimate Soil Hydraulic properties

Abstract:

Water retention curve and hydraulic conductivity are of the main soil hydraulic functions. Determination of these functions is important in many processes such as irrigation and drainage calculations, determining soil moisture deficit and modeling water flow in soil. The water retention curve describes the relationship between soil volumetric water content and the matric potential. The Hydraulic condutivity function describs the relationship between the unsaturated Hydraulic condutivity and soil volumetric water content. Since direct measurements of both functions in laboratory and field conditions are relatively costly and time-consuming considered indirect methods for measuring these functions. One method is to use particle-size distribution and soil bulk density such as Arya and Paris model. Since measured data of particle size distribution is limited, mathematical models can be fitted on available data. The fitted models can be used as input data to Arya and Paris model for estimating soil hydraulic functions. In this research seven parametric models including Jaky, Fredlund, van Genuchten, Gompertz, SL, ONL, ORL and nonparametric model of spline are used to model the particle size distribution curve. The data used were the measured particle size distribution for 24 different soils existing in UNSODA (Unsaturate Soil Database). The models compasion is performed through three oriteria, AIC, RMSE and r^2.

The results showed that nonparametric model of spline, had better performance for estimation than other models. Also in parametric models Jacky model with one parameter had better performance for estimation. On the other hand the linear relationship between the Particle Size Distribution and the Void Size Distribution presented by Arya and Paris is not true in all soil textures. In this researsh it was true in sand and silt loam soils. As a result the modification of this relation for different soil texture is suggested. It is resulted that the parameter numbers is not the only effective factors to estimate soil hydraulic properties by Arya and Paris model. Besides the best fitted model to the particle size distribution is not necessarily the best model to estimate soil hydraulic properties. Soil texture and nature of model affect also the estimation quality by models.

Keywords: Particle Size Distribution, Soil Water Characteristic Curve, Unsaturated Hydraulic Conductivity, Arya and Paris Model

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