田块尺度土壤入渗特性空间变异研究

Research on field-scale spatial variability of soil infiltration characteristics

中文关键词: 土壤 入渗 分形 修正Kostiakov公式 空间变异 归一化

英文关键词:soils infiltration fractals modified Kostiakov equation spatial variation normalization

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中文摘要:

　　土壤入渗特性是田块尺度参数估值的重要基础。该文以陕西省杨凌区一级阶地砂壤土和三级阶地粘壤土所选典型田块的双环入渗试验为基础，分析了归一化因子在单一尺度和多尺度上的分形特征，并在此基础上建立了估算归一化因子的土壤转换函数。结果表明：对于修正Kostiakov公式所采用的归一化处理方法是可行的，可较好地预测典型田块各测点的土壤入渗过程；在单一尺度上，一级阶地和三级阶地所选典型田块的归一化因子最优半方差函数均为球状模型，其分形维数分别为1.796和1.840；在多尺度上，一级阶地典型田块归一化因子的空间变异受粉粒含量、砂粒含量和土壤容重的影响显著，三级阶地典型田块归一化因子的空间变异与黏粒含量、粉粒含量、砂粒含量和土壤初始含水率相关程度最高（显著性水平0.01）；估算归一化因子的土壤转换函数具有较高的精度和可靠性，其一级阶地和三级阶地典型田块验证样本归一化因子的实测值与估算值相对误差绝对值均值分别为13.15%和9.95%。研究结果可较好地解决田块尺度内土壤入渗点面转换及入渗参数难以取得的问题。

英文摘要:

　　Abstract: Soil water infiltration characteristics is one of the important factors for estimating the infiltration parameters at field scales. Based on the double-ring infiltration experiments conducted in typical fields of the first terrace (Sandy loam) and the third terrace (Clay loam) in Yangling District, Shaanxi Province, China, the spatial variability of soil infiltration characteristics under different soil textures were studied at field scales. The objectives of this paper are to apply the normalization method for modified Kostiakov function, to analyze the fractal characteristics of normalization factors under single scale and multi scales, and finally, to develop the Pedo-transfer function for estimating the normalization factors. The results show that the normalization method is feasible for modified Kostiakov function, which has high accuracy in predicting the infiltration process of every soil infiltration experiment spot. The correlation coefficients between the predicted values of the cumulative infiltration and the measured values of all the experimental spots in the first terrace and third terrace are 0.9759 and 0.9576, the errors of the root mean square are 2.795cm and 1.266cm, and the mean absolute values of relative error are 10.58% and 9.26%, respectively. Under the single scale, the semi-variance functions of the normalization factors in first terrace and third terrace are shown to be the spherical model, the spatial variance is mainly caused by the structural elements, and the fractal dimensions are 1.796 and 1.840 respectively. The results show that the uniformity of spatial variance of the soil infiltration characteristic in the third terrace is higher than that of the first terrace. During the multi-scale analysis, the spatial variation of the normalization factors in the first terrace are greatly influenced by silt particle, sand particle, and soil bulk density, and the normalization factors in the third terrace are greatly influenced with clay particle, silt particle, sand particle, and soil initial moisture content(0.01 level of significance). The Pedo-transfer function for estimating the normalization factors is accurate and reliable, and the measured and the estimated values of the normalization factors of the verification samples in the first terrace and the third terrace are in good agreement with each other, the mean absolute value of relative error are 13.15% and 9.95%, respectively. The research results of this paper could be used to convert point-based soil infiltration measurements to regional scale.

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