吴庆华,张家发,蔺文静,王贵玲.土壤水流模式染色剂示踪及优先流程度评估[J].农业工程学报,2014,30(7):82-90

土壤水流模式染色剂示踪及优先流程度评估

Appling dyeing tracer to investigate patterns of soil water flow and quantify preferential flow in soil columns

投稿时间： 2013-10-16 最后修改时间： 2014-02-23

中文关键词：灌溉 土壤 入渗 优先流 亮蓝 示踪 原状土柱 变异系数

英文关键词:irrigation soils infiltration preferential flow Brilliant Blue FCF tracing undisturbed soil coefficient of variation

基金项目:国家重点基础研究发展计划（"973"计划）（2010CB428802）；国家自然科学基金项目（51279016）；中央级公益性科研院所基本科研业务费（CKSF201223/YT，CKSF2014058/YT）联合资助

作者	单位
吴庆华	1. 长江科学院，武汉 430010
张家发	1. 长江科学院，武汉 430010
蔺文静	2. 中国地质科学院水文地质环境地质研究所，石家庄 050061
王贵玲	2. 中国地质科学院水文地质环境地质研究所，石家庄 050061

中文摘要:

优先流是结构性土壤水分入渗的主要方式。为了直接利用土壤水流模式分析其优先流程度，该文采用亮蓝染色剂示踪原状与扰动土柱的土壤水运移，定量评估优先流的相对发育程度。研究结果表明原状土柱优先流发育，空间变异性强，受优先流通道的特征控制，其优先流水流模式以蚯蚓大孔隙流和土块裂隙优先流为主。扰动土柱的水流模式为活塞流，无优先流发育。该文提出了随深度变化的染色面积比的变异系数指示原状土柱优先流相对程度的评价准则：变异系数越低，优先流程度越高。变异系数≥0.5%为优先流程度一般发育，＞0.25%～＜0.5%之间为发育，≤0.25%为非常发育。并通过原状和扰动土柱灌溉模拟试验验证了评价准则的可靠性。

英文摘要:

Abstract: Preferential flow is a main type of soil water movement in the structured soil. Although previous researches have made a great progress in preferential flow, how to compare the level of preferential flow based on the dyed pattern of soil profile by dyeing tracers is not reported yet. Therefore, in this paper, the Brilliant Blue FCF (C.I. 42090) dye tracer experiment was designed to investigate and quantify the preferential flow in five intact and five disturbed soil columns sampled at the depth of 0-100 cm from the Experimental Station of the Institute of Hydrogeology and Environmental Engineer, Chinese Academy of Geological Science (Hebei, China) and from Luancheng Experimental Station of Chinese Academy of Science (Hebei, China). Soil water movement patterns of the intact and disturbed soil columns were compared. The results showed that the preferential flow was developed in the intact soil columns, while the piston flow in the disturbed soil columns. The characters of preferential flow in the soil profiles varied along both horizontal and vertical directions. The coefficients of variation (C.V) of the dyed area percentages in the whole profiles of soil columns were proposed to quantify preferential flow in the undisturbed columns and the capacity of soil water movement in the disturbed columns as long as 1) the irrigation conditions were same for all columns; 2) the area of preferential flow was larger than that of uniform flow in intact columns; and 3) the mass-transfer coefficients of soil water flowing horizontally from the preferential path to the matrix were same. Small C.V value represented the high levels of preferential flow in the intact columns. The C.V≥0.5% indicated the low levels of preferential flow, while C.V of >0.25%～<0.5% and ≤0.25% suggested the medium and high levels, respectively. However, the estimated principle may be not suitable for intact soil columns with different kinds of preferential path, i.e., soil cracks and plants' root and earthworm burrows. The preferential levels of the soil columns assessed by the C.V of the dyed area percentages were verified successfully by the irrigation test of undistributed and distributed columns designed to quantify the percentage of preferential flow. However, the results of preferential flow levels estimated by the C.V may be affected by size of columns, because the characters of preferential flow varied with study scales. Therefore, more studies were needed to verify the feasibility of C.V in estimating the preferential flow level. The study here proposed a quantitative method to assess the preferential flow level directly from the dyed pattern of the soil profile, and to evaluate the groundwater recharge, saving water and soil polluting in agriculture.

查看全文 下载PDF阅读器

关闭