党宏宇,陈洪松,邵明安.喀斯特地区不同层次土石混合介质对土壤水分入渗过程的影响[J].农业工程学报,2012,28(8):38-43

喀斯特地区不同层次土石混合介质对土壤水分入渗过程的影响

Effects of laminated rock fragments on soil infiltration processes in Karst regions

投稿时间： 2011-08-18 最后修改时间： 2012-03-16

中文关键词：土壤水分,入渗,模型,土石隔层,碎石粒径,桂西北喀斯特地区

英文关键词:soil moisture infiltration models laminated rock fragment diameters of ballast karst areas in northwest Guangxi of China

基金项目:中国科学院西部行动计划项目（KZCX2-XB3-10）；中国科学院知识创新工程重要方向项目（KZCX2-YW-QN404）；国家自然科学基金（41171187）

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中文摘要:

桂西北喀斯特地区土壤中常常含有土石隔层，分析其对土壤水分入渗过程的影响有助于深入研究该区水循环机理和促进植被恢复重建进程。通过室内模拟土柱试验，研究了不同土石隔层碎石粒径（5～20，20～40?mm）及土石隔层（土石质量比为1:1）位置（上层（0～20?cm），中层（10～30?cm），下层（20～40?cm））对土壤水分入渗过程的影响。结果表明，碎石粒径为5～20?mm时，土石隔层位于中层时土壤累积入渗量最大。碎石粒径为20～40?mm时，土石隔层位于下层时土壤累积入渗量最大。当土石隔层位置一定时，碎石粒径较小有利于土壤水分入渗；粒径为5～20?mm的土石隔层土壤稳定入渗速率最大，且达到稳定入渗的时间最短，但土层隔层位于下层时均质土壤及不同粒径土壤的稳定入渗速率无显著差异。土石隔层位置和隔层碎石粒径对初始入渗速率没有显著影响；土石隔层位于上层时，土石隔层的存在缩短了水分入渗运移过隔层的时间。土石隔层位于中层时，隔层碎石粒径为20～40?mm时水分入渗到达隔层及运移过隔层的时间最长。土石隔层位于下层时，隔层碎石的存在缩短了水分入渗到达隔层及运移过隔层的时间。Kostiakov入渗模型与Philip方程都可以较好地描述含土石隔层土壤的入渗过程，但Kostiakov入渗模型模拟效果更好。

英文摘要:

Laminated rock fragments (LRF) are widely existed in karst areas of Northwest Guangxi, China, and their effects on soil infiltration processes are very important for water cycle mechanisms and vegetation rehabilitation in karst region. In this paper, through laboratory soil-column experiments, the effects of LRF (gravitational soil-stone ratio=1:1) with different rock fragment sizes (5-20 and 20-40 mm in diameter) and positions (top(0-20 cm), middle(10-30 cm)and lower(20-40 cm)) on soil infiltration processes were analyzed. The results showed that the cumulative infiltration capacity was the highest when LRF was located in the middle position (10-30cm) with the size of 5-20 mm. However, when it was located in the lower position (20-40cm), the cumulative infiltration capacity reached the highest with the size of 20-40 mm. The relatively small size of rock fragments benefits soil infiltration for a certain position of LRF. When rock fragment size was 5-20 mm, stable infiltration rate was the highest and the time that reached the stable infiltration condition was the shortest. However, when LRF was located in the lower position with different sizes, the stable infiltration rates had no significant difference. The position and size of the rock fragments had no effect on the initial infiltration rate. When LRF was located in the upper position (0-20 cm), the time for wetting front to break through LRF reduced and similarly it was the longest when LRF was located in the middle position with the particle size of 20-40 mm. When LRF was located in the lower position, the time for wetting front to reach and break through LRF reduced. Both Kostiakov infiltration formula and Philip equation were suitable for simulating the change of cumulative infiltration capacity for stony soils, but the former had better simulation results.