

黄土高原生物结皮斥水性及其沿降水梯度变化特征研究

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摘要: 为探明黄土高原生物结皮土壤斥水性的影响因素及其沿降水梯度的变化特征, 在黄土高原沿降水梯度布设了8个采样区, 每个采样区选择恢复年限相近的草地或林地, 采用滴水穿透时间法和微型盘式入渗仪法测定了生物结皮与无结皮土壤的斥水时间和斥水系数, 分析了生物结皮对斥水性的影响及其与结皮特性、土壤属性和年均降水量的相关性。结果表明, 与无结皮土壤相比, 黄土高原生物结皮土壤的斥水时间和斥水系数分别增加了54.85倍和5.80倍, 但两者沿降水梯度的变化规律相似, 均呈自南向北先减小、后稳定的变化趋势, 且生物结皮土壤斥水性的空间变异性高于无结皮土壤; 生物结皮土壤的斥水时间和斥水系数与结皮厚度、粉粒含量、黏粒含量、有机质含量、年均降水量呈显著的正相关关系 ($P \leq 0.032$), 与苔藓生物量和砂粒含量呈显著的负相关关系 ($P \leq 0.030$); 非线性回归表明, 生物结皮土壤的斥水时间和斥水系数均可用结皮厚度和苔藓生物量进行模拟 ($R^2 = 0.97$, NSE 不小于0.99)。研究表明, 黄土高原生物结皮的发育显著增加了土壤斥水性, 且斥水性沿降水梯度从南到北呈先减小、后逐渐稳定的空间变化趋势, 年均降水量主要通过改变生物结皮厚度、苔藓生物量和有机质含量等理化性质而间接影响土壤斥水性。

关键词: 斥水时间; 斥水系数; 黄土高原; 降水梯度; 结皮

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Effects of Biocrust Covering on Soil Water Repellency and Its Variations along Precipitation Gradient on Chinese Loess Plateau

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Abstract: Soil water repellency (SWR) is an important indicator of soil physical property, and closely correlated to the processes of soil erosion and hydropedological processes. It was conducted to understand the effects of biocrusts on SWR and its variation characteristics, as well as its influencing factors in the Loess Plateau of China. SWR was assessed by using water drop penetration time (W_{DPT}) and water repellency index (R_i) method. Along the 292 ~ 595 mm precipitation gradient, eight sampling sites were selected and the restoration age were similar at each survey sites. The SWR of biocrusts and the adjacent bare soil on each sampling site were measured by W_{DPT} method and mini-disc infiltrometer, respectively. In the meantime, biocrusts thickness, moss biomass, moss density, bulk density, soil mechanical composition and soil organic matter were also measured to analyze its correlations with the SWR. The results showed that W_{DPT} and R_i between biocrusts and bare soil were significant at each sampling sites ($P < 0.05$). The W_{DPT} and R_i of biocrusts was average increased by 54.85 and 5.80 times as compared with the corresponding soils without biocrusts. Whether it was on the biocrusts or bare soil, the W_{DPT} and R_i showed a similar trend, which was decreasing from south to north along the precipitation gradient in the Loess Plateau of China. In addition, the spatial variability of biocrusts SWR was higher than that of bare

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