

研究简报

# 不同土地利用类型下土壤粒径分形分析——以黄土丘陵沟壑区为例

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**摘要** 土壤粒径分布影响土壤的水力特性、土壤肥力状况以及土壤侵蚀等, 是重要土壤物理特性之一。在水蚀严重的黄土丘陵沟壑区, 不同的土地利用类型对水土流失的阻截作用不同, 因而进一步导致其土壤粒径分布的差异。对不同土地利用类型下土壤粒径分布的分形和多重分形分析发现: 黄绵土土壤粒径分布包含有3个无标度区间, 分别为粘粒域、粉粒域和砂粒域; 土壤粒径分布的分形维数D、粉粒域维数Dsilt、砂粒域维数Dsand、信息维数D1、信息维数/容量维数D1/D0与土壤细颗粒含量和有机质含量成显著的正相关关系; 土地利用对分形维数D、粉粒域维数Dsilt、砂粒域维数Dsand、容量维数D0、信息维数D1、信息维数/容量维数比值D1/D0的影响较显著。这表明这些分形和多重分形参数可以作为反映土壤物理性质和土壤质量的潜在性指标, 其实用性有待进一步探讨。

**关键词** [土壤粒径分布](#) [土地利用](#) [分形特征](#) [多重分形](#) [土壤侵蚀](#)

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**Abstract** Soil particle-size distribution (PSD) is one of the most important physical attributes due to its strong influence on soil properties related to water movement, productivity and soil erosion. The fractal and multifractal measures were useful tools in identifying soil PSD with different taxonomy. Land-use type, as one of important factors to affect soil PSD, was paid little attention in the previous research. In this paper, Tyler and Wheatcraft power law and multifractal Rényi dimension were applied to characterize PSD in soils with the same taxonomy and different land-use types. Then the effects of land use on the fractal and multifractal parameters were analyzed. The study was conducted on the loess hilly areas of the Loess Plateau in China, of which the environment is characterized by hilly terrain with an altitude between 997 and 1731m, and semi-arid climate with a mean annual rainfall of 505mm and temperature of 8.6°C. A Calcic Cambisols soil was sampled from five land use types: woodland, shrub land, grassland, terrace farmland and abandoned slope farmland with planted trees (ASFP). The soil PSDs were obtained by laser diffraction technique using a Longbench Mastersizer2000. The result showed that: (1) fractal and multifractal parameters reflect different aspect of soil PSDs. There existed three power-law domains, namely Dsand, Dsilt, Dclay in all PSDs and can be ranked as Dsand > Dsilt > Dclay. The boundaries of three domains were close to the soil textural classification boundaries. (2) fractal dimension (D), dimension of silt domain (Dsilt), dimension of sand domain (Dsand), entropy dimension (D1) and entropy dimension/capacity dimension ratio (D1/D0) were significantly positively correlated with finer particle content. thus they could be potential parameters to reflect soil physical properties influenced by land use. (3) D, Dsilt, Dsand, D0, D1 and D1/D0 were correlated with soil organic matter a

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nd were influenced by land use, providing potential indicator of soil quality influenced by land use  
e. More significant result is required in the future study to test the applicability of fractal and multifractal parameters in characterizing land use effect on soil PSDs.

**Key words** soil particle-size distributions \_ land use \_ fractal characteristics \_ multifractal characteristics \_ soil erosion

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