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Tillage effect on soil microrelief fractal indices and related water erosion parameters

E. Vidal Vázquez (1), I. Bertol (2), J.G.V. Miranda (3), **A. Paz González** (1)

(1) Universidad de La Coruña- UDC, La Coruña, Spain. tucho@udc.es / Fax: 34-981167065 / Phone: 34-981167000 (2) Universidade do Estado de Santa Catarina-UDESC, Santa Catarina, Brazil. a2ib@cav.udesc.br / Fax: 55-4921019122 / Phone: 55-4932219235 (3) Universidade Federal da Bahia-UFBA, Bahia, Brazil. vivas@ufba.br / Fax: 55-7132355592 / Phone: 55-7132636682

Fractal analysis is a useful tool for characterizing soil surface roughness. Tillage influences surface soil physical conditions, and consequently soil surface microrelief. In this study fractal scaling was applied to point elevation data sets for assessing two fractal indices, fractal dimension, D, which describes how roughness changes with scale and crossover length, l, which specifies the variance of microrelief at a reference scale. A field experiment using simulated rainfall was conducted from October 1999 to May 2000, in the Santa Catarina highlands region, southern Brazil. Three soil tillage systems were tested: (a) reduced tillage (chiseling + disking), (b) typical conventional tillage (plowing + double-disking), and (c) modified conventional tillage (plowing + double-disking + double hand-harrowing). Rainfall was applied with a rainfall simulator at a constant intensity of 64 mm h^{-1}. Different water-erosion related parameters were evaluated under steady runoff rate in the studied treatments. Soil surface roughness was measured with a manual device immediately before and several times after tillage. Fractal parameters D and l were estimated using the semivariogram algorithm. Soil tillage increased surface roughness as described by crossover length, l, to different degrees, depending on the type of equipment. Reduced tillage was the most effective treatment in terms of increasing surface roughness. Water erosion parameters experimentally determined such as time to start runoff and to reach runoff-peak, runoff velocity, sediment concentration, size of eroding sediments in runoff water, soil loss rate and runoff discharge were related with fractal parameters describing soil surface roughness.