



Effect of tillage on fractal indices describing soil surface microrelief of an Oxisol

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The concept of soil surface roughness is central in the scientific description of runoff generation and sediment production. On agricultural fields, one may expect disordered roughness created by the random disposition of structural units, aggregates and clods, which is superimposed by periodic effects induced by cultivation. In turn, both types of microrelief features, disordered or random roughness and oriented or periodic roughness, may be superimposed to the natural landscape area at larger scales. Thus, roughness measurement is scale sensitive. The main objective of this study was to investigate the effect of tillage on the two fractal indices, fractal dimension, D , and crossover length, l , currently used in characterizing soil surface microrelief. The statistical index random roughness, RR , was also assessed.

Field experiments were done on an Oxisol located at Campinas, São Paulo State (Brazil). Six tillage treatments, namely, disc harrow, disc plow, chisel plow, disc harrow + disc level, disc plow + disc level and chisel plow + disc level were tested. Measurements were made four times, firstly just after tillage and subsequently after cumulative natural rainfall. Duplicated measurements were taken per treatment and date, yielding a total of 48 experimental surfaces. The sampling scheme was a square grid with 25 x 25 mm between point spacing and the plot size was 1350 x 1350 mm, so that each data set consisted of 3025 individual elevation points. All indices were calculated after trend removal, both by slope correction, i.e. oriented microrelief, and by slope plus tillage marks correction, i.e. random microrelief.

RR ranged from 7.18 to 41.86 mm after detrending for slope and from 3.76 to 23.41 mm after detrending for slope and tillage marks. Two independent methods were used for estimating fractal parameters D and l, semivariogram (SMV) and local root mean square (RMS). Fractal dimension estimated by the semivariogram method, DSMV, after corrections for slope was between 2.326 and 2.889 and after correction for slope and tillage marks was between 2.618 and 2.919. Both methods, SMV and RMS, gave equivalent results for the study indices, even if some bias was present, irrespective of trend removal procedure. After slope removal, i.e. oriented microrelief condition, D was significantly different between the three treatments with primary tillage and the three treatments with two successive tillage operations. Oriented and random D values were higher in the treatments with two tillage operations. A significant relationship between D and l was found, thus crossover length, l, and fractal dimension, D, values were not independent of each other.

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