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Effect of sediments generated by rill erosion on soil hydrology at small spatial scale: methodological and experimental issues.

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After formation, a rill may remain in the field for weeks or months contributing to a large percentage of the sediment production downstream. Recent findings show that the rill flow transport capacity of soil clods can be much different from that in overland flow depending on the prevailing discharges. It is then hypothesized that within the sedimentation area of a rill network, rill erosion is able to generate a layer of sediments whose granulometric characteristic should be different than that produced by interill erosion (i.e., by overland flow). To what extent these granulometric differences also lead to local disparities in the hydrological behaviour of the soil (e.g., infiltration rate), is uncertain. The aim of this work is (i) to determine the incidence of the sediments generated by rill erosion on the hydrological properties of the sedimentation area, and (ii) to evaluate the granulometric characteristic of these sediments. This presentation deals mainly with methodological and experimental issues while results and conclusions are presented in more detail in a companion one.

In a region strongly affected by rill erosion, a 25 m x 15 m plot containing well-defined eroded and sedimentation areas was selected to carry out experiments. Rills were obliterated by tillage and the plot was then protected by a fence during ca. one year until a noticeable rill network was again clearly developed within the experimental site. Detailed topographic surveys were made at different stages of rill system formation using a robotic-surveying, no-prism total station. In addition, rainfall during the whole period and soil moisture content at different depths (200 mm and 400 mm) were monitored using a pluviograph and TDR probes, respectively. Four contrasting treatments with 3 repetitions each were defined within the rill network: (i) A the top of the plot only affected by splash erosion; (ii) in the eroding area affected mainly by interrill erosion, (iii) in the fan-like sedimentation area of rills, and (iv) in the same location of (i) but removing the soil crust. In each of these 12 sites (4 treatments x 3 repetitions), infiltration measurements made at several tensions (= 2, 5, 12, 17 cm of water) on the same soil surface were determined using a 20-cm-diameter, tension infiltrometer. At each tension, infiltration measurements at regular times were continued as long as necessary to reach a constant infiltration rate; these measurements therefore lasted anywhere between 60 to 90 min.

Wooding's equation for steady-state unconfined infiltration rates was used in calculating unsaturated hydraulic conductivities (K). Soil samples for particle size determination (Pipette Method) were taken in the different treatments at the depths of 0-1, 0-5 and 0-10 cm. In addition, subsamples were used to

determined weight percent of soil clods of different sizes, as follows. Air-dried material was gently broken up by hand and forced through a set of nested sieves (25 mm, 10 mm, 5 mm, 4 mm, 3 mm, 2 mm, 1 mm, 0.50 mm and 0.25 mm). Smaller soil fractions (0.20 mm, 0.10 mm, 0.05 mm, 0.02 mm, 0.002 mm and less than 0,002 mm) were determined using the Pipette Method with the following adjustment to minimize aggregates breakdown by slaking. Material passing the smallest sieve (i.e., 0.25 mm) was gently moistened by capillarity until saturation and then immersed in ethanol instead of distillate water. Besides, pre-treatment for aggregate dispersion were omitted.

For all the treatments, K values decrease as tension increases converging to a small infiltration rate. Accordingly, K value increases exponentially as tension decreases but at a clearly different rate depending on the treatments. In the other hand, the coarsest soil materials were found in the sedimentation area of rills.