Variation of Sediment Concentration and Its Drivers under Different Soil Management Systems

Wentai Zhang[1,2], Xuezheng Shi[1], David Weindorf[2] and Dongsheng Yu[1]

(1) Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China, dshyu@issas.ac.cn , (2) Louisiana State University AgCenter, Baton Rouge, LA, dweindorf@agcenter.lsu.edu

Abstract

Four soil management systems, i. e., forest and grass coverage (FG), forest coverage with disturbed soil surface (FD), contour tillage (CT) and downslope tillage (DT), were exposed to two rainfall intensities (40 and 54 mm h $^{-1}$) using a portable rainfall simulator. The drivers of sediment concentration variation were determined by the variations of runoff rate and sediment concentration as well as their relationships. Sediment concentration variation was mainly driven by rainfall and management at runoff initial stage. The degree of sediment concentration variation driven by flow varied with different soil management systems. Three best relationships between runoff rate and sediment concentration were identified, reciprocal (CT), quadratic (FG and FD) and exponential (DT).

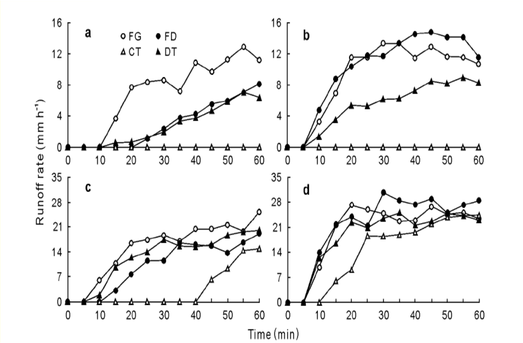
Materials and methods

Study plots are located at Jiangxi Province of China (28°15'N, 116°55'E). The soil is Argi-Udic Ferrosols (CST), referring to Ultisols (ST).

The study plots were set on a uniform 9% slope. The size of each plot was 10 m × 2.5 m . For each rainfall intensity, one dry run followed by a wet run 18 h later.

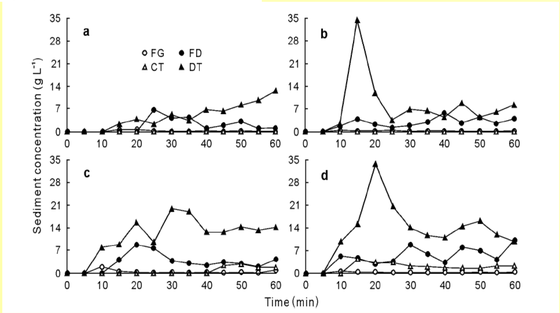
Results and discussion

Variations of runoff rate and sediment concentration



It takes 10 min before runoff starts, and runoff rates increase gradually, until a steady state is reached, which is indicated by 20% or less variation.

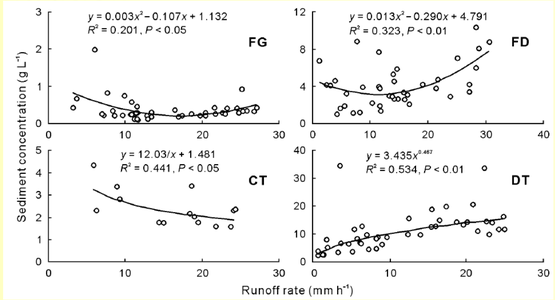
Rainfall intensity is 40 mm h $^{-1}$ for (a) and (b) and 54 mm h $^{-1}$ for (c) and (d).



Sediment concentrations for all treatments increased firstly, and then declined, until steady states were reached due to hydraulic equilibrium.

Sediment concentration reached a steady state after 20 min almost synchronal with the time when corresponding runoff rate reached such a state.

Relationships between runoff rate and sediment concentration



1) Reciprocal relationship (CT), sediment concentration was firstly affected by rainfall and surface disturbance, then decreased due to runoff dilution;
2) Quadratic relationship (FG and FD), rainfall and flow affected sediment concentration variation;
3) Exponential relationship (DT), the variation was mainly flow-driven.

Conclusions

- Both runoff rate and sediment concentration reached steady states. The two steady states were synchronal.
- Sediment concentration variation was mainly driven by rainfall and management at runoff initial stage.
- The degree of sediment concentration variation driven by flow varied with different soil management systems.