

Public Abstract

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Title: Soil Surface-Seal Measurement using High-Resolution X-ray Computed Tomography (HRCT)

Rainfall on bare soil breaks soil aggregates, detaching particles, plugging pores and decreasing porosity in the top few mm of soil. This reduces hydraulic conductivity and increases runoff through a process known as surface sealing. The objectives of this study are to measure saturated hydraulic conductivity (K_{sat}) of surface seals developed on bare Mexico silt loam (Aeric Vertic Epiaqualfs) during a simulated rainfall event, to evaluate the effect of anionic polyacrylamide (PAM) for maintaining high K_{sat} , and to evaluate models of sealing using total porosity, pore-size distribution collected with high-resolution X-ray computed tomography (HRCT). The study used a factorial design. Factors included rainfall duration (0-, 7.5-, 15-, 30-, and 60-min) at 55-mm hr⁻¹ intensity, and an untreated soil or a soil amended with 20-kg ha⁻¹ PAM. Application of PAM for various rainfall durations maintained from 20% to 41% higher K_{sat} than did untreated soil, for all times tested. Results indicated density (ρ) increased, and total porosity and pore-size decreased rapidly after a 15-min rainfall. HRCT- ρ data helped identify the best model selection for characterizing seal ρ profile. A sigmoidal model (Roth, 1997; $r^2=0.68$) and a mixed exponential model (Mualem and Assouline, 1989; $r^2=0.67$) both described seal ρ profiles well. Although the cost is expensive, HRCT-image is a valuable tool to measure soil properties by analyzing soil thickness down to 0.015-mm. The study confirms that HRCT-analysis of soil allows accurate and direct measurements of seal effects on water flow and documents the usefulness of PAM for reducing surface sealing.