

APPLICATION OF A QUININE-BASED FLUORESCENT TRACER FOR SHEET FLOW ESTIMATION UNDER SIMULATED RAINFALL

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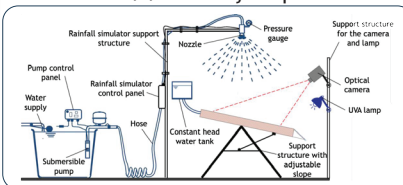
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1. Introduction and Objectives

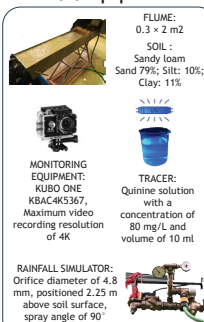
Understanding sheet flow dynamics during intense rainfall events is essential for assessing surface runoff generation, soil erosion processes, and rainfall-induced hydrological risks. When direct flow velocity measurements are not feasible, the use of velocity tracers can be a valuable tool. In this study, the applicability of a fluorescent quinine solution was evaluated for estimating sheet flow velocities under varying rainfall intensities in controlled laboratory conditions. The findings contribute to improving experimental approaches for quantifying shallow surface runoff processes, which are fundamental for advancing erosion modelling, flood prediction, and hydrological risk assessment.

2. Materials and Methods

2.1. Laboratory setup

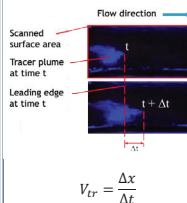


2.2. Equipment

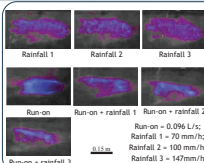


2.3. Velocity estimation

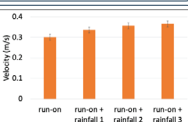
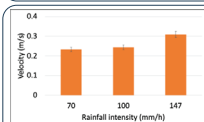
A quinine solution was injected into the sheet flow



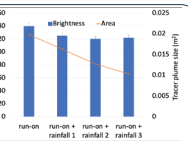
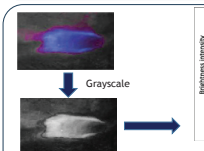
3. Results



The effect of varying rainfall intensities on the visualization of the quinine tracer plume in the sheet flow over bare soil. The images in the first row depict flow induced solely by rainfall, whereas the images in the subsequent rows illustrate flow induced by rainfall in conjunction with upstream run-on applied in the flume. All images were captured 0.5 seconds after the tracer was introduced into the flow.



Comparison of velocities estimated using quinine tracer for the sheet flow generated: (i) by different rainfall intensities (left image) and (ii) by the combination of rainfall and run-on (right image).



Comparison of the impact of rainfall disturbance on the tracer plume by assessing brightness intensity (most bright pixel) and tracer plume size across different rainfall intensities. This figure enables us to assess the persistence of the injected tracer plume and subsequently evaluate the extent to which the tracer is observed under varying rainfall intensities. The images were captured 0.5 seconds after the tracer was introduced into the flow (the same time interval used to measure the flow velocity).

4. Conclusion

When exposed to ultraviolet-A (UVA) light, quinine solution tracer can effectively estimate sheet flow velocities under varying simulated rainfall intensities, in low luminosity conditions. However, under higher rainfall intensities, the visibility of the tracer plume diminishes, presenting challenges for precise flow velocity measurements.

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