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Estimating sheet flow velocities using quinine as a fluorescent tracer in low luminosity conditions: laboratory and field experiments

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Introduction and Objectives

Quinine was used as a fluorescent tracer to estimate sheet flow velocities over various surface coverings (e.g., bare; mulched; vegetated; paved) in low luminosity conditions (e.g., night; twilight; shielded environments), based on both laboratory and field experiments. Surface flow velocities were estimated based on the injection of a quinine solution into the water flow. Our results were compared with dye and thermal tracer estimates. The objectives of this study include: (i) evaluating the applicability of quinine as a fluorescent tracer (under UVA light) when estimating sheet flow velocities in low ambient light and different surface morphology conditions; (ii) evaluating the visibility of the quinine tracer against dye and thermal tracers, for similar flow, surface and light conditions; (iii) assessing in which conditions, regarding surface morphology and light, can the use of the quinine fluorescent tracer be advantageous.

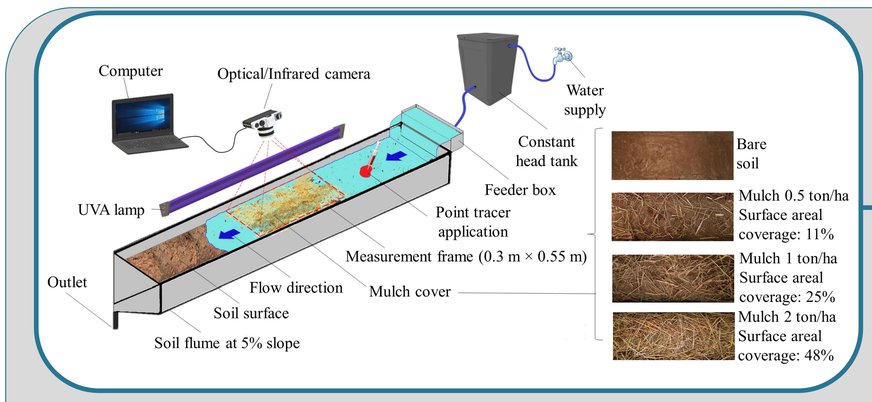
Materials and Methods

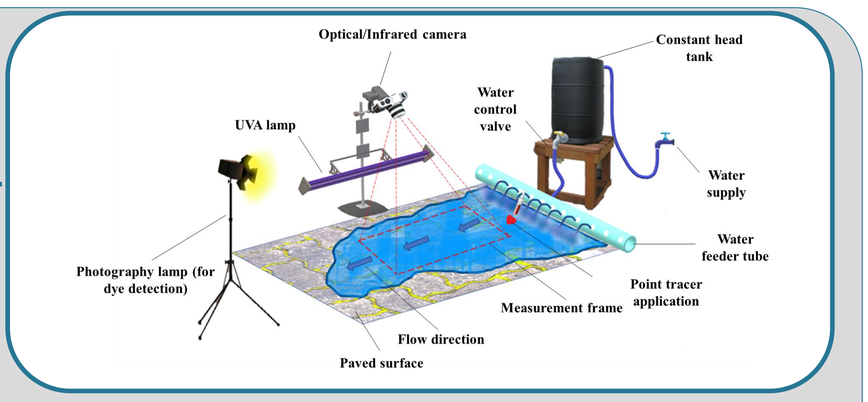
I. Laboratory Measurement Setup

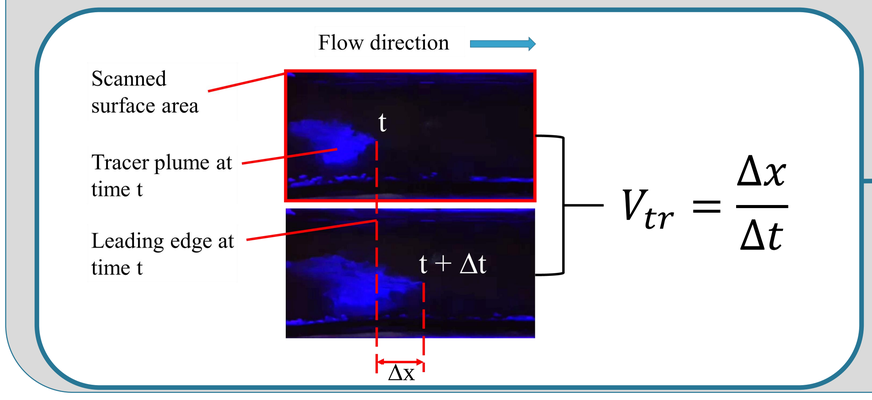
II. Field Measurement Setup

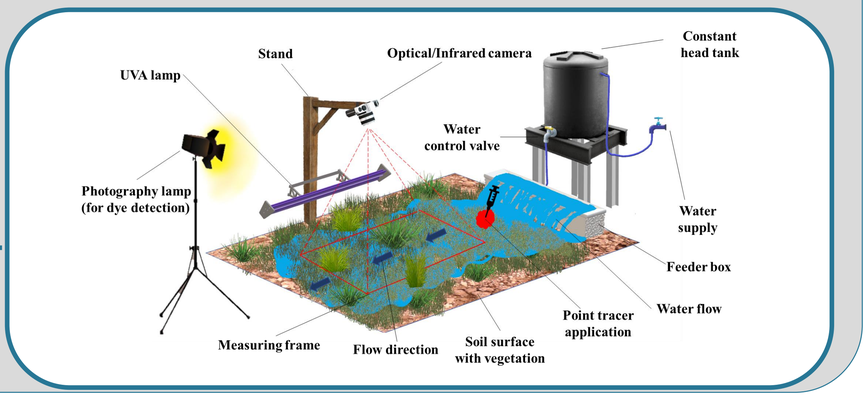
III. Tracers
1) Quinine 2) Dye 3) Thermal

IV. Video Recording System and Velocity Estimation Method

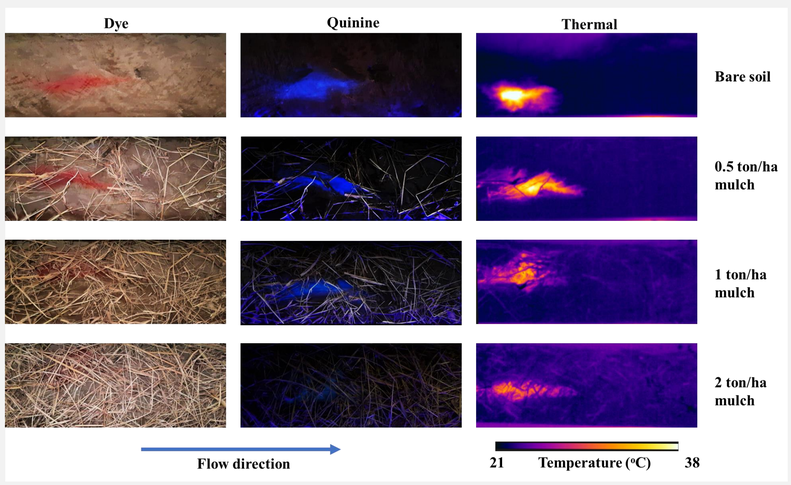


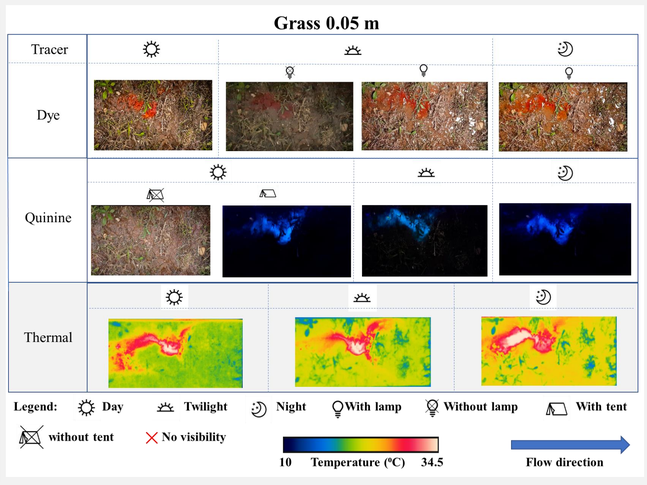


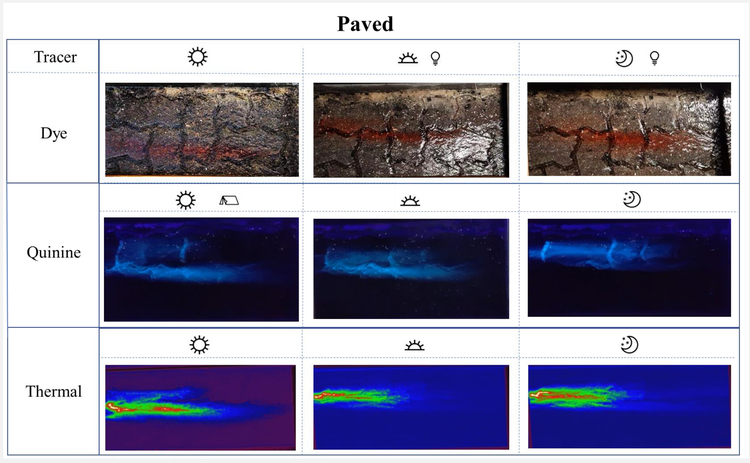




Results

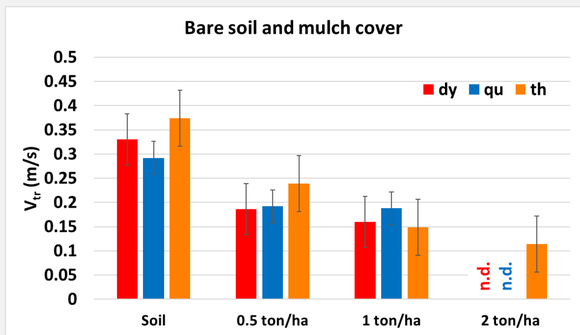


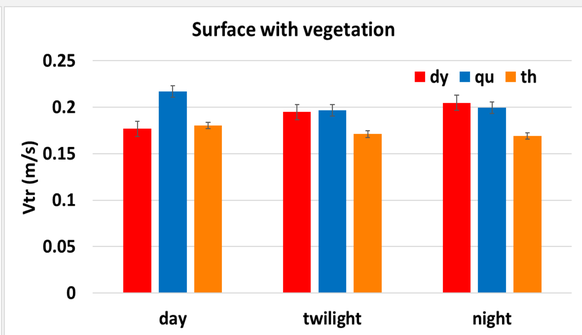


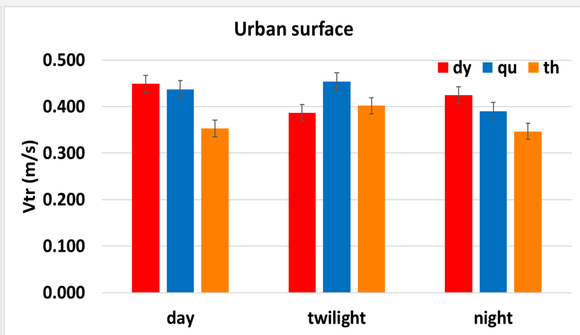


Comparison between images of three tracers over different surfaces

Comparison of surface flow velocities estimated using dye (dy), quinine (qu) and thermal (th) tracers for sheet flows over different surfaces.







Conclusion: The main advantages of using fluorescent quinine as a tracer are: (i) the high visibility of the injected tracer under low-luminosity conditions (e.g., field measurements in dark conditions, at night, twilight, shielded environments or close conduits); (ii) better visibility of the tracer in comparison to the dye tracer (iii) nontoxicity to the environment, due to the very low concentration of quinine needed to produce high fluorescence (around 80 mg/L). The restrictions of using the fluorescent quinine as a tracer are: (i) impossible to use it in bright light conditions; (ii) not suitable to use in presence of dense or tall vegetation cover or dense mulch, i.e., when the vegetation/mulch offers a surface coverage exceeding 25–30%.

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