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# Influence of soil water repellency on runoff and solute loss from New Zealand pasture

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Soil water repellency (SWR) has been reported in New Zealand, but knowledge on its importance for the country's economy and environment is limited. Our recent survey on the occurrence of SWR under pasture across the North Island of New Zealand showed that most soils exhibited SWR when dry independent of climate but influenced by the soil order. SWR is discussed as an important soil surface condition enhancing run-off and the transfer of fertilizers and pesticides from agricultural land into waterways. So far, the impact of SWR on run-off has rarely been measured. We developed a laboratory-scale **r**un-**o**ff **m**easurement **a**pparatus (ROMA) to quantify directly the impact of SWR on run-off from undisturbed soil slabs. We compared the run-off resulting from the run-on of water with that resulting from an ethanol (30% v/v) solution, which is a fully-wetting liquid even in severely hydrophobic soils. Thus, the experiments with the ethanol solution can be understood as a proxy measure of the wetting-up behaviour of hydrophilic soils.

We conducted ROMA run-off experiments with air-dried soil slabs (460 mm long x 190 mm wide x 50 mm deep) collected from pastoral sites, representing three major soil orders in the North Island: Recent Soil (Fluvisol), Gley Soil (Gleysol), and Organic Soil (Histosol), with water followed by the ethanol solution at a run-on rate of 60 mm/h. Bromide was applied at 80 kg KBr/ha prior to the water experiments to assess potential solute losses via run-off. The air-dried soils had a high degree and persistence of SWR (contact angles, 97, 98 and 104°, and potential water drop penetration times, 42, 54 and 231 min for the Fluvisol, Gleysol and Histosol, respectively). Under identical soil and experimental conditions, water generated run-off from all soils, but in the experiments with the ethanol solution, the entire ethanol solution infiltrated into the soils. The ranking of the run-off coefficients of the soils directly reflected their ranking in persistence and degree of SWR. The runoff coefficients were 96 (±2), 28 (±4), and 16 (±2.5) % for the Histosol, Gleysol and Fluvisol, respectively. However, even the extremely hydrophobic Histosol, which had a runoff coefficient of 96%, only lost 13% of the applied bromide via run-off demonstrating that run-off occurred in channels. In addition, SWR reduced the water storage by 33, 14, and 41% for the Fluvisol, Gleysol and Histosol, respectively.

We identified difficulties around the accuracy and meaningfulness of the persistence of SWR determined with the water drop penetration time (WDPT) test, which measures the persistence of SWR at a single point. In contrast, our ROMA experiments integrate the spatial variability of SWR of an undisturbed soil slab. In addition, the method is faster for extremely hydrophobic soils once the ROMA is set up. We are currently analyzing if our soil slab experiments are representative of larger scale run-off behaviour on the field.