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The physical effect of biological and chemical treatments on water repellent soils.

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Water repellence in soils is a naturally occurring phenomenon caused by long-chain hydrophobic organic molecules that affect millions of hectares of agricultural land in Australia. Breakdown of the hydrophobicity in soils has been attributed to both biological and chemical interactions, it being unclear which is the primary contributor. We employed a novel approach investigating the ability of bio-chemical treatments to breakdown the physical effects of water repellence using 3D electrical resistivity tomography (ERT). The experiment consisted of sterile soil with a hydrophilic, heat treated outer section that framed a 4 cm3 severely hydrophobic inclusion. Treatments included wax-degrading microbes, a surfactant, the combination of the two, as well as controls, all on sterile and non-sterile hydrophobic soil. The experiment used 3D, borehole ERT to measure the electric resistivity in the soil after wetting. Electric resistivities were converted to volumetric water contents allowing determination of in-situ time-lapse water contents. On all treatments, over time, there was a visible decrease in the definition of the boundary between the water repellent core and the wetting soil, with the treatment defining the pattern and speed of wetting. We observed the wetting of the surfactant treated soil with a fast, stable wetting front. Return of repellence after drying had varied outcomes for the controls, both sterile and non-sterile, with some tests returning with severe water repellence while others with no repellence, the repellence more likely to return at the lower depth. The drying of soils with the surfactant treatment showed that there was a return of repellence on all depths of excavation and these ranged from low to severe repellence. The aim of this experiment is to a better understand the hydrological impacts of the mechanisms responsible for the breakdown of water-repellent soils through how they affect the pattern and longevity of the breakdown.