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WIRE project- Soil water repellence in biodiverse semi arid environments: new insights and implications for ecological restoration

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Background

Soil water repellency (SWR) can have a critical effect on the restoration of disturbed ecosystems causing poor plant establishment and promoting erosion processes. Although SWR has been reported in most continents of the world for different soil types, climate conditions and land uses, there are still many research gaps in the knowledge of its causes and controlling factors (Doerr et al.,2000; Jordan et al., 2013), particularly in Mediterranean arid semi arid environments which are largely affected by this phenomenon. The WIRE project aims to investigate SWR in soils under different vegetation types of dominant biodiverse ecosystems of Western Australia (WA), e.g. hummock grasslands and Banksia woodlands, as well as characterizing organic compounds that induce hydrophobicity in these soils. Banksia woodlands (BW) are of particular interest in this project. These are iconic ecosystems of WA composed by an overstorey dominated by Proteaceae that are threatened by sand mining activities and urban expansion. Conservation and restoration of these woodlands are critical but despite considerable efforts to restore these areas, the success of current rehabilitation programs is poor due to the high sensitivity of the ecosystem to drought stress and the disruption of water dynamics in mature BW soils that result in low seedling survival rates (5-30%). The main objectives of this collaborative research are: i) to identify SWR intensity and severity under different vegetation types and evaluate controlling factors in both hummock grasslands and BW (ii) to characterize hydrophobic compounds in soils using analytical pyrolysis techniques and iii) to investigate the impact of SWR on water economy in relation with soil functioning and plant strategies for water uptake in pristine BW.

Methods

In a series of field trials and experimental studies, we measured SWR of soil samples under lab conditions in oven-dry samples (48 h, 105 ºC) that were previously collected under the canopy of a broad range of plant species composing the dominant vegetation communities of the study areas. Direct analytical pyrolysis (Py-GC/MS) allowed the structural characterization of soil organic matter (SOM) (Jiménez-Morillo et al., 2014). Basic soil physicochemical properties were analysed and soil microbial activity was measured with the 1-day CO_2 test, which determine soil microbial respiration rate based on the measurement of the CO_2 burst produced after moistening dry soil (Muñoz-Rojas et al., 2016).

Results

Main results of the project revealed that SWR is strongly correlated to microbial activity, pH and electrical conductivity. In soil samples under Banksia spp., Py-GC/MS analysis showed that SOM had clear signs of alteration (humified) that included a high contribution of stable families like unspecific aromatic compounds and alkane/alkene pairs. However, under Eucalyptus spp. soils showed a less altered SOM with a high relative contribution from lignocellulose (lignin and carbohydrates), together with a low relative content of recalcitrant families. In soil samples from hummock grasslands of the Pilbara region, very low contents of SOM were found.
These results point to possible indirect links between organic substances released by roots and soil wettability involving soil microorganisms. Ecological plant strategies and specific adaptations for water uptake in arid and semi-arid ecosystems of WA are likely the main drivers of SWR.

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References

Doerr SH, Shakesby RA, Walsh RPD. 2000. Soil water repellency: its causes, characteristics and hydrogeomorphological significance. Earth-Sci Rev 51: 33–65. DOI: 10.1016/S0012-8252(00)00011-8.

Jiménez-Morillo NT, González-Pérez JA, Jordán A, Zavala LM, de la Rosa JM, Jiménez-González MA, González- Vila FJ. 2014 Organic matter fractions controlling soil water repellency in sandy soils from the Doñana National Park (Southwestern Spain). Land Degrad. Develop. published online. DOI: 10.1002/ldr.2314

Jordán A, Zavala LM, Mataix-Solera J, Doerr SH. 2013. Soil water repellency: origin, assessment and geomorphological consequences. Catena 108, 1-8. DOI: 10.1016/j.catena.2013.05.005

Muñoz-Rojas M, Erickson TE, Martini D, Dixon KW, Merritt DJ. 2016. Soil physicochemical and microbiological indicators of short, medium and long term post-fire recovery in semi-arid ecosystems. Ecological indicators 63, 14-22.DOI: 10.1016/j.ecolind.2015.11.038