Above: Ana undertaking analysis of soil hydrophobicity in the laboratories of Kings Park and Botanic Garden.
Photo: Miriam Munoz Rojas

Left: A water drop on the surface of soil collected from banksia woodland.
Photo: Ana Alonso Lobo

Water repellency - why some soils don't absorb water

Ana Alonso Lobo
Kings Park and Botanic Garden
Volunteer

One of the first things that impressed me the most when I arrived in Australia was the flora. Coming from Spain, the flora here is incredibly diverse and so completely different to anything that I have ever seen. That was the main reason why I decided to volunteer in the Science Division at Kings Park and Botanic Garden.

I was given the opportunity to participate in a large collaborative project 'Soil water repellence in biodiverse semi-arid environments: new insights and implications for ecological restoration'. The project is funded by The University of Western Australia and led by Dr Miriam Munoz Rojas who is also based at Kings Park. My background is in forestry engineering, so working with and learning so much more about soil has been very exciting for me

Soil is said to be water repellent when water does not easily penetrate into the soil. Further research is needed to investigate the causes and impacts of soil water repellence (or hydrophobicity). Water repellency in soil is a naturally occurring phenomenon.

It has been hypothesised that a coating forms on soil particles that repels water, such as from plant chemicals or oils. It is primarily caused by a range of organic compounds released during the breakdown of organic matter. These compounds come from all plant species and include resins and waxes that are particularly common in evergreen trees such as eucalypts and pines. It has been suggested that eucalypts exude a wax-like substance that may increase the water repellence in eucalypt forest soils, even though no change is evident in soil characteristics (Walden et al., 2015).

However, the association between water repellence and plants may not always be direct. According to some studies, the development of water repellence has also been associated with fungal growth and soil miroorganisms as well as with soil organic matter. It has also been theorised that wildfires can cause soils to become water repellent, or move a soil's water repellence from surface to sub-surface layers (Cerda and Robichaud, 2009).

Soil water repellency is one of the major problems affecting not only Australian soils, but soil all around the world. It occurs under different climatic conditions, in different ecosystem types and in many different land uses. In Western Australia alone, more than 3.3 million hectares are affected by, or at high risk from, this phenomenon.

Pilbara landscape.
Photo: Miriam Munoz Rojas

Banksia woodland.
Photo: Jason Stevens

Water repellency can have a range of hydrological impacts and ecological consequences. These impacts are especially problematic in highly altered or degraded areas as there are likely to be huge repercussions for plant growth and soil erosion when rainfall fails to penetrate into soils with high repellency and instead pools or flows across surfaces.

In our research, we have collected a range of soil types from different areas of Western Australia. These samples included soil from the Pilbara region, and from banksia woodlands and coastal dunes in the Perth area. Samples collected from either under native plants or in areas of bare soil were then analysed. The analysis includes a measure of the persistence of soil water repellency as well as a range of physicochemical and microbial characteristics. One of the most common methods for measuring and classifying soil water repellence is the Water Drop Penetration Time (WDPT) method. This method consists of placing five drops of distilled water on the soil surface and recording the time required for complete infiltration.

So far, we have observed that water repellency is present in most of the soils sampled from the banksia woodlands and coastal dunes, but the degree of repellency varies among soil types and/or vegetation cover, with a major incidence in eucalypt woodlands. In contrast, soils from the Pilbara region are generally hydrophilic or non-water repellent.

Despite extensive research in this field, there are still clear research gaps in understanding the occurrence, and causes of, soil water repellence. This current collaboration of scientists from Kings Park, the Institute of Agrobiology and Natural Resources (Spanish National Research Council) and the University of Seville (Spain) are continuing this research.

Our next step is to identify which biological and chemical factors contribute to the development of water repellence and how these factors interact. We can then use this information to better understand soil water repellence in the Mediterranean and semi-arid areas of Western Australia.

References:

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