Soil water repellence response to soil water content depends on temperature

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EGU2018-8114

1 RATIONALE

Predicting soil water repellence (SWR) is challenging as it varies non-linearly with soil water content (SWC) and temperature[1].

Intepreting the effects of SWC on SWR is difficult as previous studies often use both oven-dried and air-dried soils[1,2,3].

The relationship between SWR and SWC at various temperatures has not been investigated.

2 OBJECTIVES

Determine if the relationship between SWR and SWC varies depending on temperature.

3 METHODS

- Soils (< 2mm) dried at 20˚C and -0.1 MPa using a vacuum oven (Fig 1A).
- Soil properties: Sand, 96%; organic carbon, 1.25%; pH_{CaCl_2} 4.91.
- Subsamples incubated at one of three temperatures (4˚C, 20˚C, 40˚C) and at various humidities (10 – 100%) for 6 days so as to modify soil water content (Fig 1B).
- SWR measured using molarity ethanol droplet[1] at 20˚C (Fig 1C).
- Gravimetric SWC measured after drying soils at 105˚C.
- Segmented linear regression used to analyse relationship between SWR and SWC at different temperatures.

A B C

Figure 1. (A) Vacuum oven, (B) soils incubated at controlled temperature and various humidities, and (C) molarity ethanol droplet measurement.

4 RESULTS

No soil water repellence response to initial increase in gravimetric soil water content (0-0.6%) at the temperatures tested (Fig 2).

A linear increase of soil water repellence response with increasing soil water content but at **rate of response differs** after 0.6% with temperature (Fig 2).

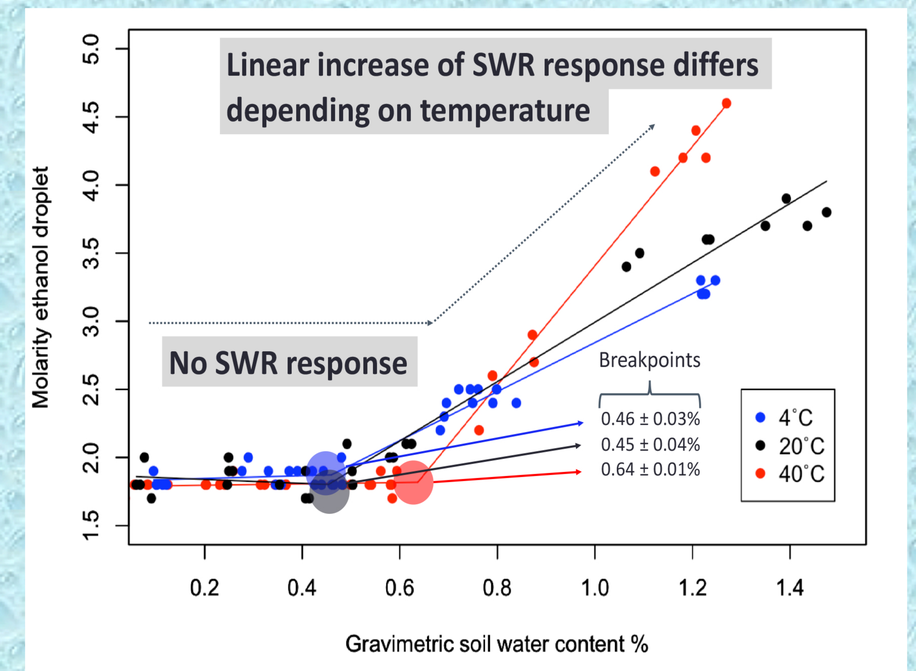

Figure 2. Relationship between soil water repellence and gravimetric soil water content % at various temperatures ˚C.

5 DISCUSSION

The lack of SWR response (Fig 2) to SWC could be related to the initial water vapour adsorption as water droplets on particle surfaces (Fig 3A).

The breakpoint might indicate the onset of thin water film formation (Fig 3B), causing SWR to increase.

The different rate of SWR response to SWC with temperature could be due to dissolution of soluble organic compounds into the thin water film.

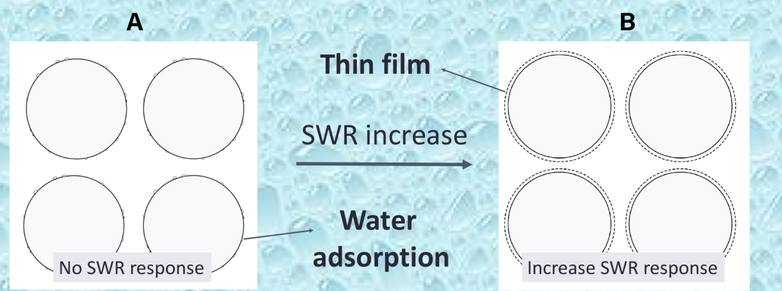

Figure 3. Conceptual model explaining (A) no soil water repellence response, and (B) increase of soil water repellence response to soil water content.

6 FUTURE WORK

- Why does SWR show an increasing response to SWC after 0.6% SWC? We are investigating this by obtaining sorption isotherms to determine if the breakpoint is a function of specific surface area of the soil particles, and whether SWR increases with SWC due to the formation of thin film.
- Further investigations are also required to understand why SWR shows a different rate of response to SWC with temperature.

References
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Acknowledgements
PhD scholarship and project is funded by Commonwealth Scientific and Industrial Research Organisation ex Grains Research & Development Corporation via Department of Primary Industries and Regional Development