

SPATIAL & TEMPORAL VARIATION IN SOIL WATER REPELLENCY IN GRASSLAND SOIL IN NORTHERN IRELAND



Katarina Pilatova¹ Oonagh Duffy¹, & Donnacha Doody²

¹School of Planning, Architecture and Civil Engineering, Queen's University Belfast, BT7 1NN, Northern Ireland

²Agri-Food and Biosciences Institute, Belfast BT9 5PX, Northern Ireland

Introduction

It is widely accepted that soil water repellency (SWR) is due to the presence of hydrophobic organic compounds that create a water repellent coating on soil mineral grains. Historically, the occurrence of SWR has been associated with dry arid regions however, more recently studies conducted within the United Kingdom have demonstrated that SWR is also of concern in more humid temperate climate such as in Ireland. There are many variables which influence the occurrence and the severity of the SWR, with parameters such as soil moisture content and organic carbon content being of greatest significance. Research on SWR in grassland soils is of agronomic and environmental interest due to its potential impact on overland flow and preferential flow and the vulnerability of grassland soils to nutrient losses. **Aim:** To investigate the spatial and temporal variability of SWR in soils in Northern Ireland (NI) and the impact of organic carbon contents and soil moisture on SWR in selected soils

Methods

- Twenty soils representing the main soil series in NI were sampled at a depth of 10 cm and air-dried and analyzed for potential SWR.
- In addition, soil samples were taken from five plots with gleyed sandy clay-loam soil on weekly basis over a 9 week period and analyzed on the same day for actual SWR and potential SWR following air drying.
- The Water Droplet Penetration Time (WDPT) test was used to measure both actual and potential SWR in the collected soil samples. An 80 µl droplet was placed on the surface of the soil using a volumetric pipette. The test comprises of applying three drops at the soil surface and measuring the time that elapses until complete infiltration occurs. The median value of the penetration times is used to categorize each sample in accordance with Doerr's (1998) classification.
- The soil moisture content was ascertained gravimetrically, while the organic carbon content was determined by the infrared absorption

Results and Discussion

Figure 1 illustrates the temporal variation in actual SWR due to soil moisture. The drier the soil the more persistent SWR tends to be. The critical threshold value above which water repellency does not occur was 0.39 m³m⁻³. The potential SWR of the sandy clay-loam samples indicated that SWR in this soil is limited to the slightly water repellent class despite a decrease in soil moisture due to air drying.

The temporal and spatial variation of SWR in NI soils, demonstrated in this study has potential implication for plant growth and soil hydrology in effected soil, particularly with the predicted decrease in summer soil moisture contents due to the impacts on climate change in NI.

Table 1 demonstrates that the persistency of potential SWR in topsoil differed amongst the selected soil types. The relationship between SWR and soil type is partially controlled by soil organic carbon as demonstrated by regression analysis (R²=0.41, p<0.01). Table 1 demonstrates water repellent soils account for 25% of the land cover of NI.

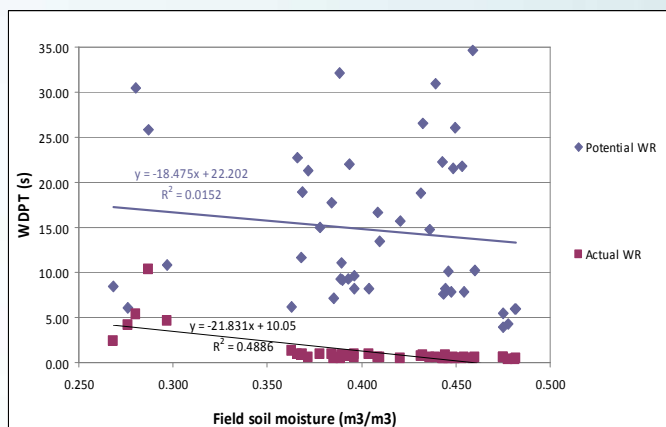


Figure 1: The relationship between actual and potential SWR and soil moisture

Soil Series	WDPT Class	Persistence rating	Area ('000 ha)	% NI total land area
Basalt till-brown earth	1	slight	17.7	1.32
Red Triassic sandstone till-brown earth	1		7.4	0.54
Carboniferous limestone till-brown earth	2		2.3	0.17
Granite rock-brown podzolic	2		12	0.89
Red Triassic sandstone till-SWG1	2		13.2	0.98
Basalt till-SWG1	3		55.5	4.13
Calp till-SWG3	3		20.7	1.54
TOTAL SLIGHT			128.8	9.57
Basalt till-SWG2	4	moderate	98.1	7.24
Carboniferous limestone till-SWG1	4		15.8	1.17
Granite till-SWG1	4		11	0.81
Shale till-SWG2	5		37.7	2.78
Calp till-SWG2	6		22.6	1.69
TOTAL MODERATE			185.2	13.69
Old Red Sandstone till-SWG1	9	extreme	13.2	0.98
(Mica-schist till-SWG2) Mica-schist till-SWHG	10		0	0
Old Red Sandstone till-brown earth	10		4.6	0.34
TOTAL EXTREME			17.8	1.32
TOTAL ALL			531.8	24.58

Table 1: Percentage of land cover for each water repellent soil type in NI based on 10cm depth WDPT test results.

References

Doerr, S.H., Shakesby R.A., Dekker L.W., and Ritsema, C.J., 2006. Occurrence, prediction and hydrological effects of water repellency amongst major soil and land-use types in a humid temperate climate. European Journal of Soil Science 57, pp.741-754.