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Faculty of Geosciences
Environmental Sciences

Nederlandse Organisatie voor Wetenschappelijk Onderzoek

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Effect of Plant-derived Hydrophobic Compounds on Soil Water Repellency in Dutch Sandy Soils

Introduction

Soil water repellency (SWR) occurs worldwide and is an important soil property, which may diminish plant growth and promotes soil erosion leading to environmentally undesired situations. Hydrophobic organic compounds coated on soil particles, derived from vegetation induce SWR and are called SWR-biomarkers. To investigate the individual or combined effects of the SWR-biomarkers on SWR, their composition in Dutch coastal dune sandy soils is analysed.

Methodology

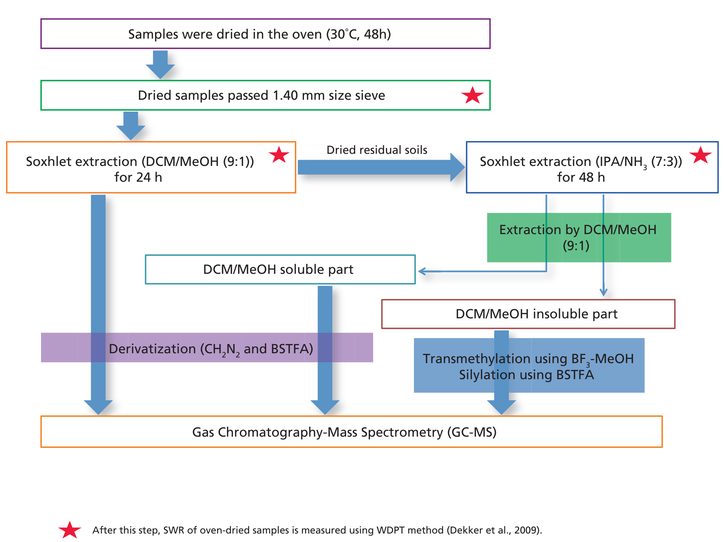

Figure 2. The diagram of the experimental procedures.

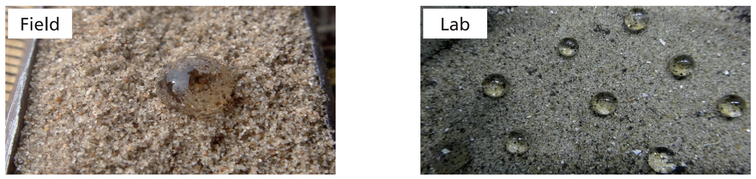

Figure 3. Water droplets stay on the water repellent soil in the field and under laboratory conditions.

Sampling sites

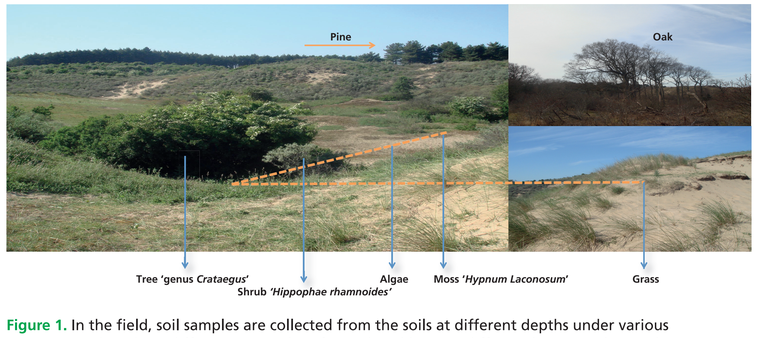

Figure 1. In the field, soil samples are collected from the soils at different depths under various vegetation. They show different SWR values for each soil layer at different locations during the on-site SWR measurements.

Results & Discussion

Soil TOC and C/N ratio

Figure 4 and 5 show the relations between soil TOC, C/N ratio and SWR before and after DCM/MeOH and IPA/NH_3 extractions. The same colours represent one and the same samples.

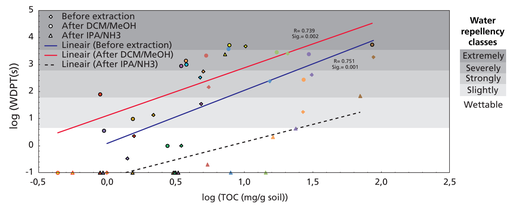

Figure 4. After DCM/MeOH extraction, SWR of most samples increases, probably because organic molecules reorganise and reorientate on the surfaces of soil particles. After IPA/NH_3 extraction, SWR is dramatically reduced for the majority of the soils.

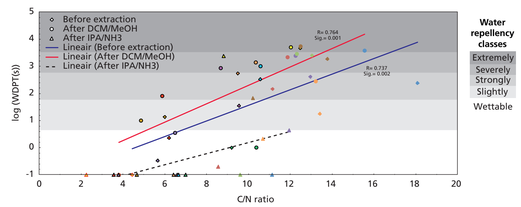

Figure 5. The average C/N ratio decreases after each extraction, because part of the C is extracted by the solvents, whereas virtually all N remains in the soil samples. Before and after DCM/MeOH extraction, there are positive significant linear relations between C/N ratio and SWR.

DCM/MeOH extracts

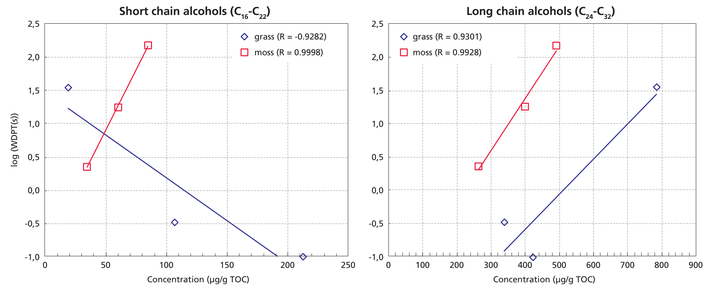

Figure 6. Alcohols represent one of the main groups in the DCM/MeOH extracts. (left) The summed concentration of short-chain alcohols (C_{16}-C_{22}) shows contrasting relations with SWR under grass and moss; (right) The summed concentration of long-chain alcohols (C_{24}-C_{32}) shows a similar relation with SWR under grass and moss.

IPA/NH_3 extracts

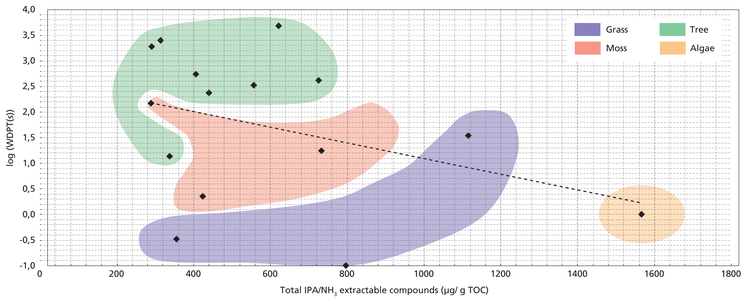

Figure 7. Relations between the total IPA/NH_3 extractable compounds (per gram TOC) and SWR. The tendency of clusters indicates that, in an order of algae, grass, moss and tree groups, lower concentration of total compounds per gram TOC leads to higher SWR.

Conclusions

- Soil TOC and C/N ratio show positive significant relation with SWR;
- The organic compounds extracted from IPA/NH_3 extraction are the main SWR-biomarkers;
- The effects of biomarkers on SWR depend on the vegetation sources;
- No clear individual biomarker signal. Next step is factorial analyses on combination of biomarkers.

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