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Hydrophobicity in sandy soils triggered by the development of Scots Pine stands in southern Brandenburg, Germany

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Soil hydrophobicity is wide-spread in forest soils and many other ecosystems and has important hydrological consequences. Therefore, the development of water repellency is an important controlling factor for hydrological processes, preventing infiltration of precipitation and has large implication for the entire ecosystem functioning. It depends e. g. on plant species, age and season of the year.

The phenomenon is defined as a situation during which the cohesive forces of water molecules are stronger than the adhesive forces between the water molecules in the soil, resulting in a high contact angle of water with the surface.

Scots Pine is the predominant forest tree on the sandy soils in southern Brandenburg, Germany. Previous studies proved that the development of hydrophobicity on sandy soils in Brandenburg is triggered by Scots Pine (*Pinus sylvestris*). Investigations of the development of hydrophobicity and their initialisation are rare. Objective of our study was to characterise the initialisation of hydrophobicity and its implication for hydrological processes in the initial phase of ecosystem development. The occurrence of water repellency can be an important abiotic factor for the ecosystem development.

We investigated the development of hydrophobicity under Scots Pines of four different age classes (young, juvenescent, mature, old) at Groß Oßnig (approx. 20 km south of Cottbus, Germany, mean annual rainfall approx. 559 mm, mean annual temperature 9.3˚C). The study site is characterised by sandy soils with pure Scots Pine forest. Due to former military activities initial stages of ecosystem development with open areas can be found in the landscape. As a pioneer tree species *Pinus sylvestris* re-colonizes such open spaces. Under juvenescent trees no soil horizons were recognizable. With increasing tree height needles accumulated under the trees and a thicker litter layer has developed.

The ´actual´ water repellency was determined *in situ* with the water drop penetration time – test (WDPT). Below the canopy of the youngest pines no water repellency was measurable, because the water infiltrated rapidly. However, below the canopy of the juvenescent pine plants slight water repellency was measured (on average 27 sec., n=6) and below the canopy of the mature pine plants the values tend to be strongly water repellent (on average 57 sec., n=6) on the substrate surface. In a depth of 1 cm the WDPT-test showed values higher than 300 sec. (n=6) and in a depth of 2 cm on average 188 sec. (n=6). Below the canopy of the oldest pine trees the values are decreasing on the surface and in a depth of 1 cm (on average 34 sec., n=6; on average 113 sec., n=6, respectively), but increasing in the depth of 2 cm (more than 230 sec., n=6). The WDPT measurements were repeated on air-dried soil samples under laboratory conditions and supplemented by the sessile drop contact angle method (CA) with a goniometer to show the ´potential´ water repellency. Additionally standard soil analyses such as soil organic matter, pH and texture were determined.

It is accepted that a connection exists between the litter of pine-needles and the water repellency of the substrate or the soil, because pine-needles exude resin-like substances with hydrophobic characteristics. Continuative studies with FTIR analysis should show, which organic substances are responsible for the hydrophobic characteristics at

this study site.

Our field measurements showed clearly, that the intensity and persistence of water repellency was accelerated with the development of the pine stands and accumulation of pine-needles in the soil litter layer.