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Impact of biocrust succession on water retention and repellency on open-cast lignite mining sites under reclamation in Lower Lusatia, NE-Germany

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Mining activities can strongly affect ecosystem properties by destruction of naturally developed soils and removal of vegetation. The unstructured substrates show high bulk densities, compaction, low water infiltration rates, reduced water holding capacities and higher susceptibility to wind and water erosion. In the initial stage of the ecosystem development, the post-mining sites are open areas without or with a low cover of higher vegetation. It is well-known that biocrusts are able to colonize the soil surface under such extreme conditions without human support and affect soil hydrological processes such as water infiltration, run-off or re-distribution. Investigations were conducted on two former lignite open-cast mining sites, an artificial sand dune on the reclaimed watershed Welzow "Neuer Lugteich" and a reforestation area in Schlabendorf (Brandenburg, north-east Germany). The aim was to relate the hydrological characteristics of the topsoil to successional stages of biological soil crusts on reclaimed soils and their influence on repellency index and water holding capacity compared to pure mining substrate. Our study emphasized the influence of changing successional stages and species composition of biological soil crusts, forming a small-scale crust pattern, on water repellency and retention on sandy soils in temperate climate. Different successional stages of soil crusts were identified from initial scattered green algae crusts, dominated by *Zygogonium* spec. and *Ulothrix* spec., and more developed soil crusts containing mosses such as *Ceratodon purpureus* and *Polytrichum piliferum*. Lichens of the Genus *Cladonia* were more pronouncedly contributed to biocrusts at later and mature stages of development. The repellency index on the one hand increased due to the cross-linking of sand particles by the filamentous green algae *Zygogonium* spec. which resulted in clogging of pores, and on the other hand decreased with the occurrence of moss plants due to absorption caused by bryophytes. The determination of the water retention curves showed an increase of the water holding capacity, especially in conjunction with the growth of green algae layer. The absorption capacity of soil crust biota as well as a decreased pore diameter in the green algae layers positively affected the water retention of crusted soil compared to pure substrate. The occurrence of bryophytes with later succession weakened the repellent behavior of the biocrusts, increased infiltration, and might have affected the run-off at small-scale on biocrusts. Certainly, the biological soil crusts showed water repellent properties but no distinctive hydrophobic characteristics. On both locations, similar trends of water repellency and retention related to crustal formation were observed, in spite of different relief, reclamation time and inhomogeneous distribution of crustal organisms.

References

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