Geophysical Research Abstracts
Vol. 12, EGU2010-4449, 2010
EGU General Assembly 2010

Functions of biological soil crusts on central European inland dunes: Water repellency and pore clogging influence water infiltration

Thomas Fischer (1), Roland Spröte (2), Maik Veste (3), Wolfgang Wiehe (1), Philipp Lange (3), Oliver Bens (4), Thomas Raab (2), Reinhard F. Hüttl (2,3,4)

(1) Central Analytical Laboratory, BTU Cottbus, Germany (thomas.fischer@tu-cottbus.de, wiehe@tu-cottbus.de), (2) Chair of Soil Protection and Recultivation, BTU Cottbus, Germany (roland.sproete@tu-cottbus.de, raab@tu-cottbus.de), (3) Research Centre Landscape Development and Mining Landscapes, BTU Cottbus (maik.veste@tu-cottbus.de, langep@tu-cottbus.de), (4) German Research Centre for Geosciences, Potsdam (bens@gfz-potsdam.de, huettl@gfz-potsdam.de)

Biological soil crusts play a key role for hydrological processes in many open landscapes. They seal and stabilize the topsoil and promote surface run-off. Three crust types were identified on two inland dunes in Brandenburg, North-East Germany: A natural, active dune, located in a former military training area near Lieberose, and an artificial dune, which was constructed in 2001 and which serves as a study area for geo-ecological monitoring of flora and fauna from the forefield of an opencast-mine ("Neuer Lugteich"). Both dunes consisted of Quarternary, carbonate-free, siliceous sandy substrate.

Utilization of the mineral substrate at early stages of microbiotic crust development was assessed using chlorophyll concentrations, scanning electron (SEM) and optical microscopy. Water repellency indices, which are an indication of surface polarity and wettability, were measured using the ethanol/water microinfiltrometer method, and steady state water flow was determined on the dry crusts and after 0, 300, 600, 1200 and 1800 seconds of wetting, thus allowing to follow pore clogging through swelling of extracellular polymeric substances (EPS).

Chlorophyll concentrations indicated early stages of crust development at both sites. In crust type 1, dominating sand grains were physically stabilized in their contact zones by accumulated organic matter and by few filamentous cyanobacteria and filamentous green algae. The pore space was defined by the mineral matrix only. In crust type 2, filamentous cyanobacteria and algae partially filled in the matrix pores and enmeshed sand grains. In the dry sample, the pore space was dominated by crust organisms but still micropore channels, which are known to increase water infiltration, were left. Crust type 3 was characterized by intense growth of filamentous and coccoid algae and cyanobacteria, and by few mosses, which covered less than 5% of the surface. Crust organisms completely utilized the substrate and clogged the pores between sand particles even in the dry sample of crust type 3.

Irrespective of the location, it was found that water repellency indices increased with initial crust development, where filamentous cyanobacteria and filamentous green algae were dominating, but decreased as coccal algae and mosses emerged. Swelling of EPS took place immediately after wetting, and its influence on steady state water flow was most pronounced in crust type 2 where filamentous cyanobacteria and algae partially filled in the matrix pores and enmeshed sand grains, still leaving micropore channels available for free water infiltration, but prior to appearance of coccal algae and mosses which formed a dense cover on the surface in crust type 3. It was concluded that mosses cause easier wettability but slower infiltration. Transition from hydrophobicity to pore clogging as ruling mechanisms causing water run-off may occur during wetting of individual biological crusts, but also during crust succession over time.

This project is part of the Transregional Collaborative Research Centre 38 "Structures and processes of the initial ecosystem development phase in an artificial water catchment" and funded by the Deutsche Forschungsgemeinschaft.