Geophysical Research Abstracts
Vol. 14, EGU2012-5034, 2012
EGU General Assembly 2012

Infiltration, water holding capacity and growth patterns of biological soil crusts on sand dunes under arid and temperate climates

T. Fischer (1), A. Yair (2), and M. Veste (3)

(1) Central Analytical Laboratory, Brandenburg University of Technology, Cottbus, Germany, (2) Department of Physical Geography, Hebrew University Jerusalem, Israel, (3) Centre for Energy Technology Brandenburg e.V., Cottbus, Germany

Water repellency and, once wetted, finer pores and grains, pore clogging as well as higher water holding capacities of biological soil crusts (BSCs) are known to inhibit infiltration and to promote surface runoff, thereby holding moisture inside the crusts and redirecting rain off the slope towards the dune base. On the other hand, available water is crucial for growth and development of crust microphytes, mosses and vascular plants. In a 2-factorial design we studied the relation between crust microstructure, infiltration and water holding capacity under arid and temperate conditions (Factor A: Climate) on BSCs sampled along a catena on mobile sand dunes (Factor B: Catena). The arid and temperate study sites were located near Nizzana, Israel (precipitation: $\sim$80 mm a^{-1}, PET: $\sim$2500 mm a^{-1}) and Lieberose, Germany (precipitation: $\sim$600 mm a^{-1}, PET: $\sim$750 mm a^{-1}), respectively. BSCs were sampled near the dune crest, at the center of the dune slope and at the dune base at each site. Scanning electron microscopy (SEM) was used to characterize BSC development and microstructure. Infiltration was determined using microinfiltrometry under controlled moisture conditions in the lab, water holding capacities were determined after water saturation of the dry BSCs. Wettability of the crusts was characterized using a "repellency index", which was calculated from water and ethanol sorptivities.

It was found that thickness and density of biogenic elements in the BSCs increased downslope at each study site and correlated positively with water holding capacities and negatively with infiltration and wettability with one exception: At the dune base of the temperate site, where water holding capacity was highest, infiltration and wettability increased again due to emergence of mosses. It is hypothesized that a positive feedback between crust growth and surface runoff intensifies downslope, resulting in highest water availability in the topsoil of the dune base. Under arid conditions, low amounts of total precipitation as well as extended periods of drought preclude growth of mosses and vascular vegetation, and facilitate the development of thicker microbiotic crusts. Under temperate conditions, however, BSCs, initially present in young ecosystems at the dune base, promote favorable for moss and vascular plant growth moisture conditions, which then take over. Hence, BSC induced water redistribution has important implications for the development of vegetational patterns on a dune scale.