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The cumulative effects of using fine particles and cyanobacteria for rehabilitation of disturbed active sand dunes

Eli Zaady (1), Itzhak Katra (2), Daniel Barkai (3), Yaakov Knoll (4), and Shlomo Sarig (5)

(1) Agriculture Research Organization, Department of Natural Resources, Gilat Research Center, Israel (zaadye@volcani.agri.gov.il), (2) Department of Geography and Environmental Development, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel (katra@bgu.ac.il), (3) Agriculture Research Organization, Department of Natural Resources, Gilat Research Center, Israel , (4) Agriculture Research Organization, Department of Natural Resources, Gilat Research Center, Israel , (5) The Katif Research Center, Sdot-Negev, Mobile Post Negev, 85200, Israel (shlomosarig@gmail.com)

One of the main problems in desertified lands worldwide is active wind-borne sand dunes, which lead to covering of fertile soils and agricultural fields. In regions with more than 100 mm of annual rainfall, sand dunes may be naturally stabilized by biocrusts (biological soil crusts). One of the main restraints of biocrust development is the typical lack of fine particles in sand dunes. Our study investigated the combined application of fine particles [coal fly-ash <100 micrometer] and bio-inoculant of filamentous cyanobacteria, isolated from nearby natural stabilized sand dunes, on the soil surface of active sands for increasing resistance to wind erosion. Boundary-layer wind tunnel experiments were conducted in experimental plots within a greenhouse for examining the effects of adding coal fly-ash and bio-inoculant to active sands. The biocrust development was evaluated via several physical and bio-physiological variables. In all the physical measurements and the bio-physiological variables, the treatment of "sand+inoculum+coal fly-ash" showed significant differences from the "sand-control". The combination led to the best results of surface stabilization in boundary-layer wind tunnel experiments, with the lowest sand fluxes. The filamentous cyanobacteria use the fine particles of the coal fly-ash as bridges for growing toward and adhering to the large sand particles. The cumulative effects of biocrusts and coal fly-ash enhance soil surface stabilization and may allow long-term sustainability.