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Soil surface protection by Biocrusts: effects of functional groups on textural properties

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In drylands, where vegetation cover is commonly scarce, soil surface is prone to wind and water soil erosion, with the subsequent loss of topsoil structure and chemical properties. These processes are even more pronounced in ecosystems subjected to extra erosive forces, such as grasslands and rangelands that support livestock production. However, some of the physiological and functional traits of biocrusts (i.e. complex association of cyanobacteria, lichens, mosses, fungi and soil particles) make them ideal to resist in disturbed environments and at the same time to protect soil surface from mechanical perturbations. In particular, the filaments and exudates of soil cyanobacteria and the rhizines of lichen can bind together soil particles, forming soil aggregates at the soil surface and thus enhancing soil stability. Also, they act as "biological covers" that preserve the most vulnerable soil layer from wind and runoff erosion and raindrop impact, maintaining soil structure and composition. In this work, we evaluated soil textural properties and organic matter content under different functional groups of biocrusts (i.e. cyanobacteria crust, 3 lichen species, 1 moss species) and in bare soil. In order to assess the impact of livestock trampling on soil properties and on Biocrust function, we sampled three sites conforming a disturbance gradient (low, medium and high impact sites) and a long-term livestock exclusion as control site. We found that the presence of biocrusts had little effects on soil textural properties and organic matter content in the control site, while noticeable differences were found between bare soil and soil under biocrusts (e.g., up to 16-37% higher clay content, compared to bare soil and up to 10% higher organic matter content). In addition, we found that depending on morphological traits and grazing regime, the effects of biocrusts changed along the gradient. For example, soil under the lichen Diploschistes diacapsis, with thick thallus and rhizines, had a positive effect on clay content under continuous grazing (moderated and heavy grazing), but no under seasonal grazing (heavy grazing). Also, we found that cyanobacteria crusts increase more than any other biocrust functional type the clay content in the more disturbed site (heavy continuous grazing). These findings highlight the relevant functional roles performed by biocrusts in vulnerable and threatened ecosystems, and call for the use of biocrusts as powerful tools in soil management and ecosystem services restoration.