



## Biological soil crusts as hotspots of managed soils in mesic environments

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Biological soil crusts, or “biocrusts”, are biogeochemical hotspots that significantly influence ecosystem processes in arid environments. Biocrusts play an important ecological role in the pedosphere and can improve nutrient availability and fertility, influence plant germination, increase biogeochemical cycling, keep and enhance water availability at the soil surface, increase soil aggregate stability, and protect the soil surface by counteracting soil erosion from water and wind. Although they cover large areas, particularly in managed sites with frequent anthropogenic disturbance, their importance in mesic environments is not in the focus of research so far. As in arid regions, biocrusts can significantly affect soil nutrients, soil degradation as well as the water balance here; however, their persistence may differ. The essential requirements for biocrust development include bare soil and a minimum amount of light. These conditions act as a starting point for biocrust establishment and succession in mesic environments and can either occur in special habitats such as sand dunes or mining heaps or be created by disturbing or removing layers of vegetation and litter. Recent studies have found mesic biocrusts mostly at managed, anthropogenically impacted sites such as monospecific forest plantations, broadleaf-mixed forests under heavy machining, and agricultural fields.

Based on their ecological functions, biocrusts bear the potential to act as novel tools for sustainable soil management. They have already been explored as possible means to restore degraded soils such as in the rehabilitation of salt heaps and burned forests. As a consequence of global climate change with a larger frequency of extreme weather events such as heavy rainfalls or extended droughts, soils will become more vulnerable and require new forms of management. Accordingly, biocrusts could make a significant contribution considering their partly high abundance in managed mesic environments. As the study of biocrusts in mesic environments is still in its infancy, further elaboration on their dynamics, distribution, and potential impacts on ecosystem services is needed. Therefore, we call for interdisciplinary physical, biological, microbiological, chemical, and applied soil science research with a special focus on biocrusts of

managed soils from mesic environments, to better understand their impact on overall ecosystem health and resilience, particularly due to climate change.