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Mycobiota of biological soil crusts in the Negev desert, Israel – differences on a regional and local scale

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On a regional scale, we examined variations in microfungal communities inhabiting the biological soil crusts (BSC) and non-crusted soil of the northern and central Negev desert in 10 locations along a southward rainfall gradient (from 325 mm to 81 mm of annual rainfall). A total of 87 species from 49 genera were isolated using the soil dilution plate method. The mycobiota of BSC (80 species) was characterized by dominance of melanin-containing fungi, remarkable contribution of sexual Ascomycota, and low abundance of the typical soil genera Penicillium and Aspergillus. Morphological adaptations to the stressful desert environment were expressed in the prevalence of dark-colored microfungi with large, many-celled spores in the localities of the "drier" part of the rainfall gradient and in dark thick-walled fruit bodies of sexual ascomycetes. The abundance of melanin-containing species with multicellular spores was the only characteristic showed a highly significant (negative) correlation with the rainfall amount. We assume that the main factor influencing the content of these species was the latitudinal position of the locations, determining also the intensity of solar (UV) radiation. In the BSC communities, the xeric "desert" component (melanics, slow-reproducing fungi with large, thick-walled spores) was significantly more pronounced and the mesic "forest" component (Penicillium, fast-reproducing fungi with small, light-colored, and thin-walled spores) was much less represented than in the non-crusted shrub communities. In BSC, density of fungal isolates which can be considered an indirect characteristic of fungal biomass was significantly lower than in the non-crusted soil. Cluster analysis indicated that in most cases, the BSC and shrub localities, separated only by a few meters or less, differed on microfungal community structure much more significantly than BSC or shrub localities in the distance of tens of kilometers. The results of this analysis, together with the fact that the rainfall amount weakly influenced spatial variations of the most observed mycological characteristics, indicated that microenvironmental (edaphic) factors played a more essential role in the formation of studied communities than macroenvironmental (climatic) factors.
On a local scale, we studied variations in microfungal communities from different crust types (cyanobacterial - moss-dominated) at the Nizzana research station, the western Negev Desert, and their relationship with moisture retention time and intensity of solar radiation. A total of 78 species from 48 genera was isolated. Microfungal communities in the Nizzana crusts were also dominated by melanin-containing species with large, thick-walled and multi-celled conidia. Abundance of this xeric group significantly increased with the increase of radiation intensity, while abundance of mesic Penicillium spp. and Zygomycota displayed the opposite trend. Density of microfungal isolates showed significant positive non-linear relationship with moisture retention time. The moss dominated crust differed markedly from the cyanobacterial crusts on species relative abundances, diversity level, and isolate density. The study showed the parallelism between structure of crust microfungal communities along a regional precipitation gradient in the Negev desert and within a small drainage basin of the Nizzana research station.