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Microfungi of Israeli soils – remarkable differences along regional climatic and local microclimatic gradient

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We compared the local adaptive patterns of soil mycobiota revealed in different Israeli microsites located in (i) the northern Mediterranean region (native and agriculturally disturbed), (ii) the southern Negev desert, and (iii) the northern and central Negev desert along a rainfall gradient. The comparative analysis demonstrated remarkable differences in spatiotemporal structure of the microfungal communities and their biodiversity level (species richness, heterogeneity, and equitability). Open south-exposed native localities of the northern microsites with moderate level of microclimatic stress supported abundant development of melanin-containing species with small, one-celled conidia. Remarkably, located only 50-150 m apart, microclimatically mesic north-exposed forest localities as well as agriculturally disturbed habitats with soil degradation selected as dominant light-colored fast-reproducing Penicillium species. By contrast, microclimatically extremely stressful desert localities were overwhelmingly dominated by slow-reproducing, dark-colored species with large, multi-celled conidia. Both mild forest and hardly stressful desert environments were rather constant and stabilized the spatial and seasonal structure of the microfungal communities, while the communities from the variable south-exposed localities were subjected to remarkable spatiotemporal changes. Comparative analysis of the biological soil crusts (BSC) and non-crusted soil of the northern and central Negev desert in locations along a southward rainfall gradient showed that in BSC microfungal communities, the xeric "desert" component (melanin-containing species) was significantly more pronounced, and the mesic "forest" component (Penicillium species) was much less represented. The weak influence of rainfall on spatial variations of most observed mycobiotic characteristics indicated that microenvironmental factors (soil moisture, temperature, organic matter content) influenced the development of studied desert communities more essentially than macroenvironmental (climatic) factors. At the population level, the estimated by microsatellite markers genetic divergences in populations of the ascomycetous fungus Emericella nidulans from the soil of the northern Mediterranean and the southern desert microsites, corresponded to geographical distances and climatic-ecological differences between these microsites. In general, environmental natural selection appeared to be the major factor affecting adaptive diversity patterns of soil microfungal communities and populations in the studied regions.