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Interconnectivity of Pore Volume and Fungal Colonisation of Soil: combining X-ray Micro tomography and Soil Thin Sections.

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The heterogeneity of the 3-dimensional pore space within soil makes it a unique habitat for the diverse microbial population, as multitrophic interactions in soil depend on the interconnectivity of habitats, and not just on the interactive capability of organisms. Too often we fail to recognise (or indeed exploit) the complexity of the soil habitat in order to provide effective soil management. Here we show how novel X-ray micro-tomography can be used to characterise non-destructively the soil structure and pore volume, and use 2-D soil thin sections to visualize the spatial distribution of fungal hyphae.

We visualised the 3-dimensional pore space for replicated samples at bulk-densities ranging from 1.2 to 1.6 with an X-TEK benchtop micro-tomography system with resolutions up to 30 μm. For the same samples, we used biological thin sections (30 μm thick) to obtain high resolution mapping of hyphal distribution and 2-D pore space in soil. Particular noteworthy was the difference in connectivity of the pore volume. At low bulk-densities (1.2 – 1.4) almost the entire pore volume is part of 1 single pore, occupying 75-95% of the pore volume. At higher densities, areas in the pore volume were isolated from each other, or connected through pore necks $<$30 μm. This was accompanied by an important shift in fungal colony morphology with dense colonies in compact soil to large sparse colonies in soil with lower BD's. Further development of the combination of these techniques will introduce rich opportunities to manipulate the soil environment to our advantage, i.e. to identify ways that optimise the interac-

tions between fungal pathogens and their antagonists.