



## Fractal analysis of fungal mycelium in soil

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Fungal mycelia, like many naturally irregular structures, are approximately fractal. Thus, fractal dimension is useful for quantifying the extent to which mycelia permeate space. Both surface/border and mass fractal dimensions are appropriate, as it is important to be able to quantify space filling at mycelial margins and within systems, respectively. Using fractal dimensions has revealed differences in space filling, in 2 dimensions across the surface of soil, by different fungal species and by the same individual over time, under different abiotic regimes, during confrontation with other mycelia, following invertebrate grazing and mechanical damage. Fractal dimensions alone do not reveal the whole picture of growth and distribution of biomass of fungi. Linear extension rate, surface coverage and qualitative descriptions are useful to use together with fractal dimension, as mycelia can sometimes have very different branching patterns despite having similar values for fractal dimension and/or surface coverage and/or extension rate. Further, other mathematical tools, such as network analysis, are valuable adjuncts to fractal dimension, since they can quantify connectedness within different parts of systems, and can be used to examine effects of breaking connections, i.e. robustness/resilience. To date studies have been in 2-dimensional microcosms, thus immediate future priorities must be to try to visualise the distribution of mycelia in 3-dimensions, and to relate the fractal nature of soil to mycelial distribution.