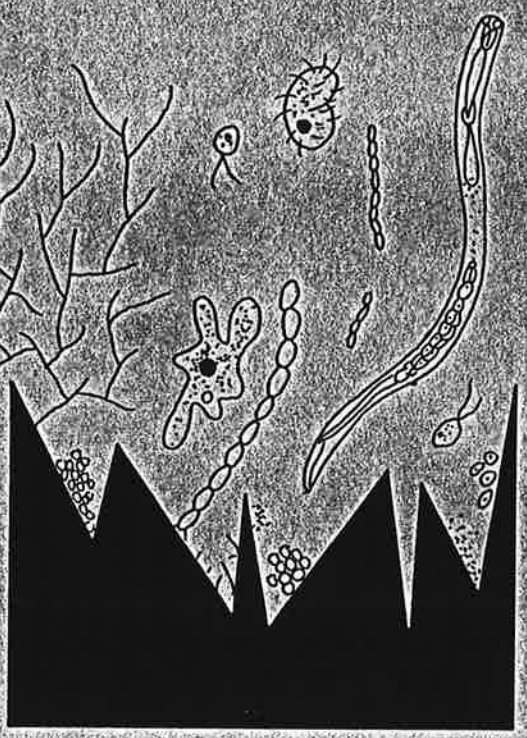
# Beyond the Biomass



## Compositional and Functional Analysis of Soil Microbial Communities

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# Measurement of the community structure of the soil microbial biomass

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Addition of plant material to soil is generally considered to favour the development of a fungal-dominated soil microbial biomass. Conversely, a bacterial-dominated biomass is usually considered to develop when a $CHCl_3$-fumigated soil is incubated following fumigant removal. These treatments may thus give us ways of altering the bacterial: fungal ratio in soil.

When 13 soils were incubated either unamended, amended with ryegrass or incubated following $CHCl_3$ fumigation, remarkably close linear relationships were found between three different methods of estimating the biomass: fumigation extraction (FE), ATP and substrate-induced respiration (SIR). Therefore, if the treatments did alter the structure of the microbial community in soil as indicated above, then the results indicate that both soil fungi and bacteria have the same SIR response and ATP concentrations.

An attempt was made to estimate the size of bacterial and fungal biomasses by using SIR in combination with streptomycin and cycloheximide to selectively inhibit bacterial and fungal respiration (selective inhibition). Surprisingly, the SIR response following inhibitor addition suggested an approximate fungal:bacterial ratio of 80:20 for each of the three soil treatments. A possible explanation is that the fungal:bacterial ratio was not altered by treatments as different as fumigation or addition of plant residues. An alternative explanation is that selective inhibition measurements may fail to reliably estimate the sizes of the fungal and bacterial populations in soil.

These results will be presented and discussed. Microscopic estimations of the bacterial and fungal population sizes in the different soils are now underway. These results will also be presented if available. Despite the difficulties involved we still consider that microscopic measurement of the microbial biomass remains the standard technique against which all other estimates of gross microbial community structure stand or fall.

# Problems with ATP measurements as an index of biomass in glucose amended soils

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Soil adenosine 5'triphosphate (ATP) content has been shown previously to be closely correlated with the amount of soil microbial biomass and so ATP provides an independent measure of the amount of microbial biomass in soil.

In the method we use to measure ATP [1] soil is ultrasonified with a reagent containing 0.5M trichloroacetic acid (TCA). The TCA's role is to instantaneously and irreversibly denature ATPases which would otherwise dephosphorylate microbial ATP to ADP or AMP during the ultrasonic disintegration of the microbial cells.

Some of the microbial ATP released during extraction is sorbed by soil particles. An approximate correction is made for this by measuring the recovery of a known amount of added ATP (the spike) from soil. In unamended soils, recoveries of this spike of added ATP usually range from about 60–80%. However, we have found that the recovery of this spike from soils which received glucose within the preceding 2 days or less was, very unexpectedly, extremely low (0–20%) yet extraction of native microbial ATP appeared unaffected.

All our evidence so far points to there being an exocellular ATPase produced by the biomass as it decomposes the glucose during this early period. This ATPase can even apparently function in TCA for a short time. This phenomenon seems to disappear by about three days after glucose addition and is also suppressed by large additions of inorganic P.

Reference

[1] Jenkinson, D.S. & Oades, J.M. (1979). *Soil Biol. Biochemistry* **11**, 193–197.