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The survival strategy of the soil microbial biomass

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The soil microbial biomass (biomass) is defined as the sum of the masses of all soil microorganisms > 5000 μm3 (e.g. fungi, bacteria, protozoa, yeasts, actinomycetes and algae). Typically comprising about 1 to 3 % of total soil organic matter (SOM), the biomass might be though to live in a highly substrate-rich environment. However, the SOM is, normally, only exceedingly slowly available to the biomass. However the biomass can survive for months or even years on this meagre energy source. Not surprisingly, therefore, the biomass exhibits many features typical of a dormant or resting population. These include a very low rate of basal and specific respiration, a slow rate of cell division (about once every six months on average) and slow turnover rate. These are clearly adaptations to existing in an environment where substrate availability is very low. Yet, paradoxically, the biomass, in soils worldwide, has an adenosine triphosphate (ATP) concentration (around 10 to 12 μmol ATP g-1 biomass C), and an Adenylate Energy Charge (AEC = [(ATP) + (0.5 ADP)]/[(ATP)+(ADP) + (AMP)]) which are typical of microorganisms growing exponentially in a chemostat. This sets us several questions. Firstly, under the condition of extremely limited substrate availability in soil, why does the biomass not mainly exist as spores, becoming active, by increasing both its ATP concentration and AEC, when substrate (plant and animal residues) becomes available? We surmise that a spore strategy may put organisms at a competitive disadvantage, compared to others which are prepared to invest energy, maintaining high ATP and ATP, to take advantage of a 'food event' as soon as it becomes available. Secondly, since SOM is available (although only very slowly) to the biomass, why have some groups not evolved the ability to mineralize it faster, obtain more energy, and so gain a competitive advantage? We believe that the reason why organisms do not use this strategy is, simply, that they cannot. Our explanation is that the rate of mineralization of humified SOM is not, as usually believed, regulated by microbial activity but by abiotic processes which are outside of the control of the biomass. We do not yet know what these processes are. They could involve diffusion from soil aggregates, oxidation processes, free radical reactions, other mechanisms, or none of these. We will present experimental evidence in support of our hypothesis – termed "The Regulatory Gate Hypothesis". If correct this hypothesis will have serious implication for our understanding of soil organic matter dynamics, CO_2 evolution from soil and climate change.