Bacterial Growth Efficiency in Soil Under Different Land Managements

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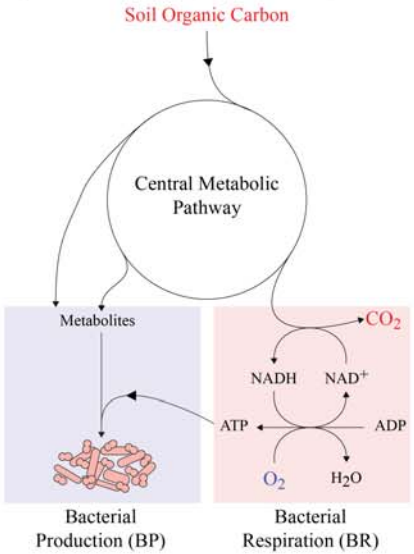
Objectives

- To compare bacterial growth efficiency (BGE) in soils that are differently managed.
- To identify factors that drives variation in BGE.

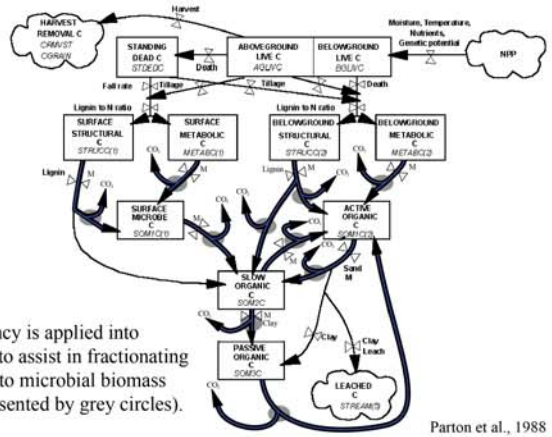
Bacterial Growth Efficiency

Aerobic heteretrophs in soil play an important role in soil organic carbon transformation. This role can be quantified as bacterial growth efficiency (BGE).



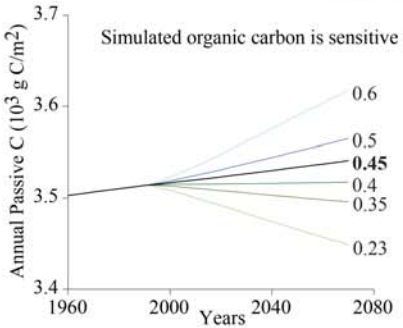
$$BGE = \frac{BP}{(BP+BR)}$$

Microbial-Driven Carbon Transformation in Carbon Models



Growth efficiency is applied into carbon models to assist in fractionating carbon pools into microbial biomass and CO_2 (represented by grey circles).

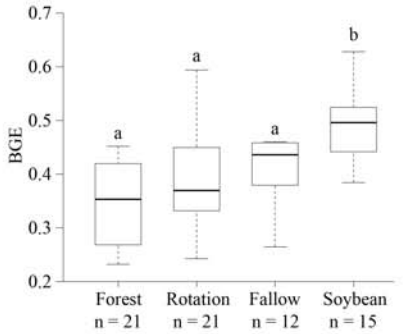
Parton et al., 1988



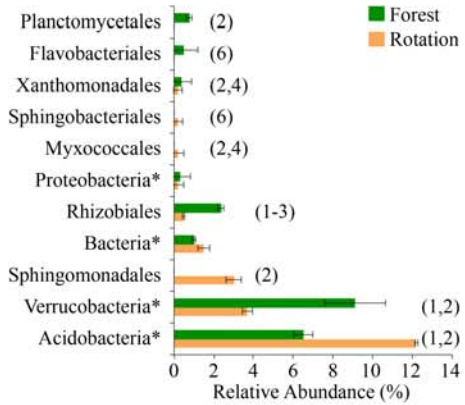
Simulated organic carbon is sensitive to variation in growth efficiency.

Models currently assume the efficiency to be 0.45. It is treated as a fixed parameter, where the same efficiency is used for different land management and carbon stability.

Variation in BGE in Terrestrial Ecosystem

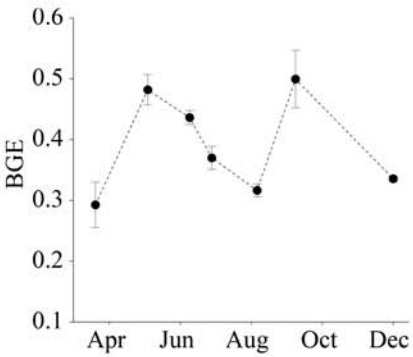


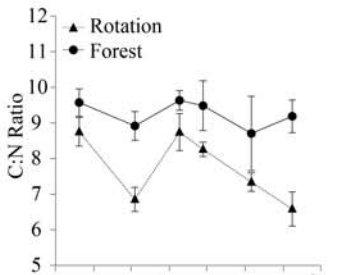
Bacterial Community in Forest and Rotation Sites

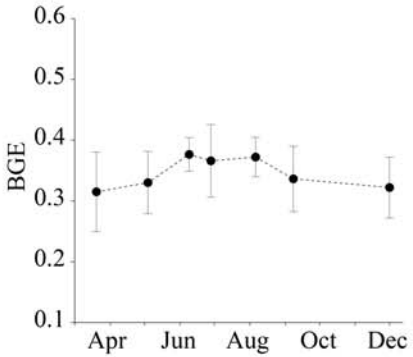


Ribosomal RNA (*rrn*) operon copy number is a genetic indicator of ecological strategy of the species. Bacteria with fewer *rrn* operons are known to be more efficient than fast-growing high *rrn* operon copy number bacteria. Forest and agriculture soils have bacterial community with different structures (at the order level) but the 20 most abundant members in each community have similar *rrn* operon copy number (indicated in brackets).

Seasonal Variation in BGE is Land Management Specific







BGE in the rotation soil exhibits a seasonal variation that is not observed in the forest site. The increased BGE observed in May coincides with the application of nitrogen fertilizer, which decreases the C:N ratio. This suggests that nutrient balance is an important driver of bacterial-driven carbon transformation in soil. Furthermore, no changes in C:N ratio was observed for the forest soil.

Conclusions

- Bacterial community in soils that are differently managed can have different growth efficiencies.
- Seasonal variation in BGE in agriculture soil is potentially driven by changes in C:N ratio.
- Changes in the structure of bacterial community do not necessarily change the efficiency of carbon transformation.
- Site-specific GE must be used to reflect an accurate SOM dynamics because simulated SOM is sensitive to changes in growth efficiency.