Underappreciated microbes now get credit for holding down two jobs in soil

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Coupled with the transformation and cycling of carbon compounds produced by plant photosynthesis, the soil “microbial carbon pump” moves carbon derived from microbial synthesis into soil, where it can become stabilized by the “entombing effect.” The yin-yang symbol represents how the microbial carbon pump is driven by the counterbalanced activities of different microbial functional groups that together drive the movement of carbon from vegetation to soil. Credit: US Department of Energy

In soil, bacteria and other microbes are well known for their ability to decompose organic materials, releasing carbon to the atmosphere. Less understood is how microbes add persistent carbon compounds to the soil.

Scientists reviewed both roles via the concept of a "microbial carbon pump." The pump is proposed as a mechanism for integrating how the contrasting breakdown and synthesis activities of microbes—coupled with the "entombment" of microbial residues—influence carbon levels in the soil.

The review offers a new view of the dual roles microbes play in creating and maintaining healthy soils. Details on microbial functions in soil are essential to improve computational models. They also are vital for informing national and global discussions on soil sustainability and vulnerability. Soil health impacts crop growth, ecosystem services, and climate.

The dynamic balance between inputs versus decomposition of organic materials regulates carbon cycling in the soil. Microbes are widely investigated as major mediators of decomposition, particularly through the effects of their extracellular enzymes. Less studied is the impact of microbial growth and death on the creation of soil carbon compounds. Because the living biomass of microbes in soil is small, microbial contributions to the formation of soil carbon compounds have been underappreciated. But the rapid life cycle of microbes can produce large amounts of organic residues over time. Even though microbial residues can be intrinsically easy to decompose, recent studies suggest a significant portion can be stabilized in soils by intimate physical and chemical associations with soil minerals.

Researchers reviewed the contrasting metabolic roles that microbes play in the cycling of soil carbon compounds (that is, catabolic breakdown and anabolic formation). The concept of a soil "microbial carbon pump" is borrowed from marine literature and coupled with the "entombing effect" (stabilization of microbial residues via interactions with soil minerals) to create a framework for stimulating and guiding new research efforts targeted at the role of microbial synthesis and turnover

in the formation of persistent carbon compounds in soils.

More information: Chao Liang et al. The importance of anabolism in microbial control over soil carbon storage, *Nature Microbiology* (2017). DOI: 10.1038/nmicrobiol.2017.105

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