Tools of the trade

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Using pyrocosms to determine fire impacts on soil molecules

Global wildfire activity is increasing, causing ecosystems to be burned more frequently and at hotter temperatures. Wildfires can alter the presence and abundance of soil organic molecules such as amino acids, organic acids, and sugar molecules. These molecules are important nutrient sources for microbes and vegetation; thus, changes in molecular abundance can influence the post-fire recovery of forested ecosystems. However, the specific organic molecules present in burned soil are often unknown owing to a lack of soil metabolomic analyses. Additionally, burned areas are often inaccessible, making it difficult to collect soil samples from burned ecosystems.

Pyrocosms (steel containers filled with soil on which vegetation is ignited and burned to mimic wildfires) can be used to determine and compare the molecular content of burned soil across different locations. By burning soil and vegetation collected from different environments, pyrocosms can simulate various wildfire conditions across a diverse range of ecosystems. For instance, soil burn temperature is controlled by burning different quantities of vegetation on the pyrocosm. Thermocouples are inserted at multiple soil depths within the pyrocosm to monitor soil temperature and estimate burn intensity (a key metric that influences changes in soil chemistry), providing data that is unavailable when sampling naturally burned areas. Additionally, non-targeted gas chromatography–mass spectrometry can be employed to identify molecules in the burned soil samples.

Using this approach, soil from a pine-dominated forest was burned with pine vegetation; sugar molecules and amino acids were subsequently detected in the burned soil. Post-fire microbes could consume these molecules to fuel microbial repopulation, promoting soil and forest recovery. Similar experiments should be conducted for a range of soil types, vegetation types, and burn temperatures to better understand which molecules influence post-fire forest recovery in different ecosystems.

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Competing interests

The author declares no competing interests.

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