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Hardwood Forest Soils Are Sinks for Plant-Produced Volatiles

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New research identifies temperature, moisture, and soil fungi as important factors in influencing how biogenic volatile organic compounds cycle between plants and the atmosphere.

In the Morgan-Monroe State Forest in southern Indiana, researchers studied how trees associated with different types of root fungi affected the storage and exchange with the atmosphere of volatile organic compounds produced by plants. Credit: D. Tyler Ro

Biogenic volatile organic compounds (BVOCs) are carbon-containing molecules released into the air by plants. They act as signaling molecules between trees—in a kind of airborne chemical communication—and play important roles in larger climate processes by facilitating aerosol formation and ozone production. Forest soils can store BVOCs and influence the compounds' exchange with the atmosphere, functions that are affected by variables that scientists are keen to understand, such as the types of trees present and associated fungi growing in the soil.

In a new study, *Trowbridge et al*. analyzed BVOCs in situ from two types of soil within a hardwood forest in south central Indiana. The first type was beneath trees that associate with arbuscular mycorrhizal fungi (AM), a type of symbiotic fungus that penetrates the cells of tree roots to form a network of nodes where sugar, gas, and nutrients are exchanged. The second type of soil was beneath trees that associate with ectomycorrhizal fungi (ECM), which form tiny exchange nets around plant roots but do not breach the root cells themselves. Scientists often find substantial differences in soil biogeochemistry between AM- and ECM-dominated forest stands: For example, AM-associated tree species drop litter that decays more rapidly and cycle nutrients faster than ECM-associated tree species.

Overall, the new analysis shows that both soil types studied work as net BVOC sinks during the growing season; however, other factors, like temperature and moisture, are critical to understanding the larger picture. ECM soils absorbed more BVOCs than AM soils, especially as temperatures warmed. ECM soils were also much more active when moisture levels were higher. Finally, ECM soils showed stronger seasonality, acting as sources of BVOCs before the growing season but then becoming strong sinks after leaf out. AM soils, on the other hand, were weak BVOC sinks year-round.

The scientists conclude that characterizing forest soil by tree-associated mycorrhizal associations may be a good first step in capturing landscape-scale variation in BVOC transport between the land and atmosphere. (*Journal of Geophysical Research: Biogeosciences,* https://doi.org/10.1029/2019JG005479, 2020)

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