Unexpected finding shows climate change complexities in soil

by Staff Writers

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In a surprising finding, North Carolina State University researchers have shown that certain underground organisms thought to promote chemical interactions that make the soil a carbon sink actually play a more complex, dual role when atmospheric carbon levels rise.

In a paper published in the Aug. 31 edition of Science, North Carolina State University researchers show that important and common soil microscopic organisms, arbuscular mycorrhizal fungi (AMF), play a role in sequestering carbon below ground, trapping it from escaping into the atmosphere as a greenhouse gas.

Yet at the same time, the study shows, elevated levels of atmospheric carbon dioxide also increase a number of underground decomposing interactions that cause carbon to be released back into the atmosphere as a greenhouse gas. This greenhouse gas release essentially offsets any carbon sink benefits, the researchers found.

AMF have a win-win relationship with plants. The fungi take carbon from plants and provide nitrogen and other useful soil nutrients that plants need in order to grow and develop. Present in the roots of about 80 percent of plants that grow on land, AMF help hold this carbon in the ground by putting the brakes on the decomposition of soil organic matter, which prevents the carbon in the decomposing material from escaping into the atmosphere as a greenhouse gas.

But in four independent experiments described in the paper, the researchers show that plants increase their demand for soil nitrogen in the form of ammonia when atmospheric carbon levels rise. Sensing this need, AMF spur other soil micro-organisms to help fill the plant's need for ammonia. To do so, soil micro-organisms decompose soil organic matter, which allows the carbon to escape into the atmosphere.

"We showed that the fungi previously thought to control carbon in the soil can increase carbon decomposition when atmospheric carbon dioxide levels are elevated," says Dr. Shuijin Hu, associate professor of plant pathology at NC State and the corresponding author of the paper. "But if we effectively manage the nitrogen transformation process in the soil, we have a chance to manage carbon sequestration in the soil."

The study was funded by the U.S. Department of Agriculture (USDA). Drs. H. David Shew and Thomas Rufty co-authored the paper, as did Drs. Fitz Booker and Kent Burkey, who work at NC State and the USDA's Agriculture Research Service. The paper's first author is former NC State graduate student Lei Cheng; postdoctoral researchers Cong Tu and Lishi Zhou also co-authored the paper.

Arbuscular Mycorrhizal Fungi Increase Organic Carbon Decomposition Under Elevated CO2. Authors: Lei Cheng, Cong Tu, Lishi Zhou, H. David Shew, Thomas W. Rufty, Shuijin Hu, North Carolina State University; Fitz Booker and Kent Burkey, U.S. Dept. of Agriculture, Agriculture Research Service and North Carolina State University. Published: Online Aug. 30, 2012, in Science