Soils Limited in Storing Carbon and Mitigating Global Warming, Studies Find

August 18 2008

(PhysOrg.com) -- Soils, long known to be potential natural "sinks" or storehouses for carbon, are limited in just how much carbon they can stash away, according to two recent studies by researchers at UC Davis; University of Kentucky; University of Bonn, Germany; and Agriculture and Agri-Food Canada.

The findings have implications for how to moderate rising levels of atmospheric carbon, closely linked with the global warming phenomenon.

Results of these studies, led by post-doctoral researcher Haegeun Chung and graduate student Sabrina Gulde of UC Davis' Department of Plant Sciences, appear in the May-June and July-August issues of the Soil Science Society of America Journal.

Scientists have known for some time that the Earth's soils are a tremendous repository for carbon. As plants grow, they take in carbon from the atmosphere and process it into plant tissue. When the plant dies, the carbon is incorporated into the soil, where it becomes bound up with soil particles and microorganisms.

"Because carbon can reside in soils for a long time in a stable form, soils harbor, on the average, two-thirds of the carbon in the land-based ecosystem," Chung said.

She noted that several long-term studies have indicated that as plants continue to add more carbon to the soils, the carbon "sequestered," or stored, in the soils increases proportionately. But other research has found that, in some soils, the levels of carbon in the soil did not increase, despite the addition of more carbon from decayed plant matter.

This suggested that there might be an upper limit to the amount of carbon that can be held by the soil, or in other words, soils can literally become saturated with carbon.

To explore the possibility of a carbon saturation of soils, carbon storage levels of soils were investigated in two agricultural experiments that have been going on for more than 30 years.

In Kentucky, Chung and colleagues studied soils from an experiment where corn is grown under a broad range of fertilizer application rates and two tillage practices.

In another study based in Lethbridge, Canada, Gulde and colleagues analyzed soils cropped to barley under a wide range of manure application rates.

The researchers collected soil samples from the plots and measured overall soil carbon levels. They also separated the soils into various soil-size fractions, and examined their carbon-holding capacity.

As Chung, Gulde and their colleagues suspected, their data indicated that there was a limit to the amount of carbon that could be stored by soils. When high levels of carbon were added through plant growth or manure application, the soil did not sequester carbon anymore. Moreover, the very small-particle components of soil had the least carbon-binding capacity and were saturated with carbon at relatively low levels of carbon addition.

"The Earth's soils have the potential to offset global carbon dioxide emissions from fossil fuel burning by as much as five to 10 percent," Chung said. "Knowing the limits of soils to serve as carbon sinks will allow environmental planners to better predict just how much carbon different soils can sequester."

Collaborating with Chung and Gulde were Professor Johan Six of the Department of Plant Sciences at UC Davis, John Grove of the University of Kentucky, Wulf Amelung of the University of Bonn, and Chi Chang of Agriculture and Agri-Food Canada.

Provided by UC Davis

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