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Researchers Say New Farm Practices will Help Fight Climate Change

New program seeks ways to store carbon in agricultural soils

Researchers report that new farm practices and new breeds of crops may provide a way to control carbon dioxide and other heat-trapping greenhouse gases that contribute to global warming.

According to a July 2 press release, a nine-university consortium has begun a \$15-million research program aimed at finding ways to increase the retention of carbon dioxide in agricultural soils and develop new crop plants that help to store carbon – a process known as carbon sequestration.

The Consortium for Agricultural Soil Mitigation of Greenhouse Gases (CASMGs) says that as much as 20 percent of the projected carbon emissions reduction called for by the Kyoto Protocol could be accomplished by using U.S. farmland and carbon sequestration techniques. The protocol, once ratified, would require about 40 industrialized countries to reduce worldwide emissions of carbon dioxide. The Bush administration opposes the treaty, saying it would harm the U.S. economy.

Green plants and trees, as they grow, grab carbon dioxide from the atmosphere and convert it to tissue. After they die, the carbon is incorporated into soil material. Fossil fuels such as coal and oil, which are carbon-based – originally from plants – release carbon into the atmosphere as they are burned. Carbon is also released from the soil when a plow turns over the soil before planting.

Charles Rice, director of the CASMGs program, said the goal is to determine the potential for implementing carbon sequestration into agricultural soils. "Economic analysis suggests that carbon sequestration in the soil is one of the most beneficial and cost effective options available for reducing greenhouse gases," he said.

Researchers said adding carbon to the soil will also help farmers by improving tillage, soil structure, nutrient retention, rooting depth and stability.

Following is the text of the press release:

Purdue University

July 2, 2002

Researchers Arming Farms to Halt Increases in Greenhouse Gases

West Lafayette, Indiana – New farm practices and new breeds of crops might someday add to mankind's toolbox for controlling greenhouse gases that contribute to global climate change.

Research under way at Purdue University seeks to control the most prominent of these greenhouse gases, carbon dioxide, by corralling carbon on the farm in a process known as carbon sequestration.

The research is being supported with a grant of nearly \$1 million to Purdue from the Consortium for Agricultural Soil Mitigation of Greenhouse Gases (CASMGs, pronounced "chasms"), a nine-university consortium of which Purdue is a member. Kansas State University is administering the \$15 million program.

According to CASMGs, as much as 20 percent of the projected carbon emission reduction called for by the Kyoto Protocol could be accomplished by using U.S. farmland.

Ronald Turco, professor of agronomy and director of the CASMGs program at Purdue, said that such a decrease would be enough to offset the United States' annual contribution to carbon dioxide in the atmosphere.

"We're hoping that with enhanced agricultural production methods we can take that annual increase to zero just by trapping the plant residue carbon in soil," Turco said.

U.S. Sen. Richard Lugar, R-Ind., was among those who worked to secure funding for the project.

"Purdue scientists have a long history of cutting-edge agricultural research," Lugar said. "Participating in a joint agricultural research venture to capture carbon from the atmosphere will help ensure that Indiana remains in the forefront of cutting-edge research. Purdue is to be commended for their participation in this ambitious project."

In addition to production practices to aid carbon retention, Turco said it will be possible to develop new crop plants that also help sequester carbon.

"Much of the carbon is held in the soil in what we call aggregate soil structures, and we'll be looking to find exactly what part of the plant goes into creating those aggregate structures," he said. "Once we know which parts of the plant are involved, we can genetically modify plants to increase the amount of those plant materials in our crops."

According to Turco, the process of reducing carbon dioxide starts with plants.

As they grow, green plants and trees grab carbon dioxide from the atmosphere and convert it to tissue. After they die, the carbon in their tissue is incorporated into soil material and can remain in the soil for hundreds or thousands of years.

Some of that carbon is released naturally into the atmosphere as carbon dioxide, but human activity has sped the process.

Fossil fuels, such as coal and oil, are carbon-based, originally from plants, that release carbon into the atmosphere as they are burned. Also, cutting forests can cause an increase in carbon dioxide in the atmosphere as carbon that was held in the trees is released.

Carbon can be released from the soil into the atmosphere when it combines with oxygen. This can happen when a carbon-based fuel, such as gasoline, is burned. But it also can happen when a plow turns over the soil before planting.

"Every time you put a plow in the soil it lets in oxygen and stimulates microbial activity," Turco said. "Increased microbial activity will result in carbon dioxide being released into the atmosphere."

Charles Rice, professor of agronomy at Kansas State University and director of the CASMGS program, said carbon dioxide in the atmosphere began rising in the 1700s and continued until today.

"Approximately 50 percent of the carbon in the soil, which was held in the organic matter, has been lost over the last 50 to 100 years in the United States," Rice said. "However, rather than look at this as a loss, we can look at it as the potential for returning and storing carbon in agricultural soils."

Increased carbon dioxide in the atmosphere is one suspect in the rising global temperature, known as global warming.

"Although it's called global warming, that's really misleading because although the overall temperature goes up, some parts of the earth may actually see lower temperatures," Turco said. "Instead of calling it global warming, we should call it global climate instability because what we are seeing is more extreme weather."

Although scientists have not found a direct cause-and-effect relationship between increased carbon in the atmosphere and global climate instability, it is known that carbon dioxide in the atmosphere has increased 30 percent over the past 200 years. Rice said the CASMGS program will be investigating ways that agriculture can reduce greenhouse gases such as carbon dioxide.

"The goal is to determine the potential and how to implement carbon sequestration into agricultural soils," he said. "We are also looking to reduce the other greenhouse gases in an agriculture system, particularly nitrous oxide and methane."

Research has shown that agriculture holds the key to fast, inexpensive reduction in greenhouse gases, Rice said.

"Economic analysis suggests that carbon sequestration in the soil is one of the most beneficial and cost effective options available for reducing greenhouse gases," he said. "This is particularly true over the next 30 years until we are able to develop alternative energy sources with less use of fossil fuels."

Turco says adding carbon to the soil will do more than help the environment. It also will help farmers by improving soil quality.

"Putting carbon in the soil improves tilth, soil structure, nutrient retention, rooting depth and stability. All of the good things you can think of with soil are attributable to adding carbon and increasing soil organic matter," Turco said.

In addition to improving the soil, farmers may also see a more direct benefit in the form of payments.

According to CASMGS, the potential market for carbon credits is \$1 billion to \$5 billion per year over the next 30-40 years.

"You can imagine a stock exchange-type trading system where farmers sell carbon credits to companies that need to buy them to stay in compliance with environmental regulations," Turco said.

Purdue, through its partnership with CASMGS, is developing a Web-based system that would allow such trading to take place.

Bernie Engle, professor of agricultural and biological engineering, is developing a Web site that would list the amount of carbon sequestered at particular sites, such as individual farms.

"We've built similar Web sites for water quality and other environmental issues in agriculture," Engle said. "Since carbon uptake is related to so many environmentally friendly farming practices, such as no-till, this is a natural extension of our work."

The Web site relies on computer modeling to determine the amount of carbon held in the soil.

"It's expensive to test how much carbon is in the soil, so a farmer can't do many tests," Engle said. "What we can do instead is take a few measurements and combine that information with information about the types of farming practices and environmental conditions found at that site and predict the amount of carbon uptake using these computer models, which are very good."

Such a Web site could eventually be used to sell carbon credits, Engle said.

"Our goal is to take the data from these computer models, combine it with the agronomic and environmental information in our databases, and put the information on a Web site," Engle said. "Farmers would then be able to sell carbon credits to companies that need to purchase credits to stay in compliance with environmental regulations."

In addition to the research efforts, CASMGS also emphasizes outreach programs to share information about carbon sequestration with farmers, agribusinesses and other groups.

Sylvie Brouder, associate professor of agronomy and director of the outreach effort for the Eastern Corn Belt said the goal is to let farmers and others know their management options.

"We want all audiences to gain a better understanding of the potential for agricultural soils to serve as a sink for atmospheric carbon, which will lead to a reduction of greenhouse gases," she said. "Our objective is both to lay the groundwork for the development of sound public policy and to educate the farmers so that they can make informed decisions about changes in their farm management."

Brouder said the Purdue CASMGS group will be developing publications and training modules to complement the outreach effort.

In addition to Purdue, universities participating in the consortium are Colorado State University, Iowa State University, Kansas State University, Michigan State University, Montana State University, the Ohio State University, Texas A&M University and the University of Nebraska.

Also participating are the U.S. Department of Energy's Battelle-Pacific Northwest National Laboratory and U.S. Department of Agriculture scientists from the Agricultural Research Service, the Natural Resource Conservation Service and the Economic Research Service.

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