

Fertilization timing may affect greenhouse gas emissions, corn yields

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Greenhouse gas emissions and carbon footprints are often heard buzz words these days.

Agriculture scientists are becoming a part of the global movement, studying ways that production agriculture affects greenhouse gases and greenhouse gas emissions.

"We know that greenhouse gases are produced in the soil, and different agricultural practices influence the production of these gases," said Rebecca Phillips, environmental scientist at the USDA - Agricultural Research Service lab in Mandan, N.D.

Scientists at the Northern Great Plains Research Laboratory (NGPRL) are measuring three gases in the soil - carbon dioxide, methane and nitrous oxide - which are known to trap thermal radiation from the earth.

"Their molecules are very good at trapping heat for us to prevent the earth from completely cooling every night. That's why they call it the greenhouse effect. It's a natural process but there has been more of a concern because of what we need to do to manage these gases," Phillips said.

Phillips said scientists at NGPRL are trying to find out if "we can do anything different in our agricultural management to possibly affect the production of these gases that occur in soil."

The current year-long experiment is specifically researching if fertilization timing (whether fields are fertilized in the early spring or right before planting), affects greenhouse gas emissions and yields.

"We know in other parts of the world there's been a lot of work that suggests the timing of fertilization influences our greenhouse gas emissions but we haven't seen much in the way of work in the Northern Plains," Phillips said.

She said there haven't been many studies that have looked at how greenhouse emissions might affect yields, either. That will also be a part of the study.

If results show that the timing of fertilizer affects gas emissions, producers might be able to change when they apply fertilizer during the year. But yields will also play a factor in those decisions, too, she added.

"If yields are the same, but the greenhouse gas emissions are higher in one of these, then producers can say, 'hey, I can modify when I fertilize in order to reduce those (gas emissions),' " Phillips said.



Producers and others at Friends and Neighbors Day in Mandan, N.D. listen to the latest in corn management research from Joel Ransom, NDSU.

Scientists are starting their work from a hypothesis that most of the fertilizer applied in April would have been emitted in a gaseous form by the end of May, according to Phillips.

"We would have seen a lot less nitrogen availability in May for the ones that were fertilized early," she said. "By fertilizing it (the corn) on May 12, you might have more fertilizer available to the plant, maybe the yields would be a little higher and maybe the nutrients would go toward the plant rather than the production of gases."

Because there is so much soil variability on different days, the study can't just look at one isolated day or event, she said. If the year remains abnormal, such as not having enough planting degree days in the growing season, more than one year of data will be needed to yield any usable results.

Corn is the crop being used in the experiment because of certain assumptions about it and gas emissions, Phillips said. Some believe corn could be a greater greenhouse gas emitter than other crops because it is heavily fertilized in certain parts of the country, she said. However, no one knows for certain because the testing data is not there yet.

"Wheat has greenhouse emissions too, but a lot of people think it is a function of how much fertilizer you put down, (not of the crop itself), but it just needs to be tested," she added. "We are not certain what effect wheat versus corn has, compared to what effect adding 50 pounds versus 100 pounds (of nitrogen) has."

The scientists divided a field into 10 plots, with separate treatments for each. Five plots were fertilized with urea on April 1 and five were fertilized with urea on May 12, right before no-till planting corn into sunflower residue on May 15.

The same kind of fertilizer and same rates were used on all the plots.

"The only difference was the timing," Phillips said. "This was a controlled experiment with five replicates in order to test our hypothesis that timing of fertilization might influence yield and greenhouse gas emissions."

It's an ongoing experiment with researchers are out in the fields every other day measuring the gases, she said, adding they hope to have final results by next year.

Scott Bylin said he mapped the field using GPS, brought back the data and built the plots. Each plot is 30 feet wide by 1,000 feet long which is about eight acres, he said.

There are three points in each of the plots for a total of 30 points that the scientists collect gases from every other day. Soil samples were taken and NPK analysis was conducted.

"We set our yield goal for 70 bushels on this plot, and used a blend of 62 pounds nitrogen, 35 pounds of phosphate and 10 pounds of potassium," he said.

Bylin said at each point, a static gas chamber was put in after fertilization on April 3. Measurements began on April 4.

As of mid July, the crew had taken 46 rounds of measurements, three times a week depending on weather.

Each one of the 30 points is visited four times. The covers are put on the chambers for about an hour so researchers can analyze what that piece of soil does in one hour. To

date, they have about 5,600 time points that have been visited so far, and they will continue to do that through the rest of the season until harvest.

At each point, a 6-inch soil core is pulled at each spot, and an analysis is conducted on that sample.

Results from April 4 through June 12. were compiled on a graph for participants at Friends & Neighbors Day at NGPRL-Mandan to see.

The graph shows the total greenhouse gas flux for each day during that time. from April 4 to June 12. The greenhouse gas flux is measured in pounds of CO₂ units (all the gasses in one unit) per acre per day, Phillips said. Nitrous oxide is 300 times more effective at trapping heat than carbon dioxide. That number is weighted and included as part of the greenhouse gas flux unit.

"At the beginning of April it (the flux) was pretty slow. There wasn't much activity, cool and dry," Bylin said, adding that by the end of May and in June, they were getting much higher fluxes and were starting to see a treatment effect.

Data from June 12 on is still being compiled, Bylin said. Also, yield data will be collected after harvest to add to the data that the team already has.

April Blackbird showed how samples were collected. To collect the soil sample, she took the cover off the top, and took a sample with the syringe, inserted into the vial. Samples were taken four times within a 45-minute period.

The gas collected in the vial is then transported to the lab and put in a gas chromatograph which separates the gases and gives a reading for each gas.

Phillips said very early data did not show much difference between gas emissions after early fertilization or late fertilization near planting.

"We expected to see higher emissions after fertilization in April but we didn't see that. Both the April 1 and the May 12 fertilizations tended to show fairly equal gas emissions," she said. "We are not seeing much of an effect of fertilization on emissions which is contrary to popular knowledge that after you fertilize a field you should see a big burst of gas emissions. But it was also very cold and very dry."

As the spring progressed and rain events came on, the gas flux rose.

"In May, it was warmer and that's why we started to see a little higher gas emissions in the fields that were fertilized later," she said. "Also in May, and then in June, rain with the higher temperatures contributed to higher fluxes. Just as the plants respond well to those conditions (rain and higher temps), so do the microbes that produce these gases."

Phillips said Dr. Archer will look at the economics of the system when the results are in.

"As far as the carbon footprint, we hope to get Dr. Archer and talk to him about putting in the economics in all the numbers, including urea, and all the fuel that was required in a whole system model," she said.