Greenhouse gas emissions study under way by AgriLife Research

April 5 2010

Texas AgriLife Research scientists in Amarillo are embarking on a new study amid recent concerns over greenhouse gas emissions from crop fertilization, tillage and feed yard operations.

Dr. Ken Casey, AgriLife Research air quality engineer, and Al Caramanica, a research chemist, have added a few new laboratory tools to help measure three greenhouse gases: nitrous oxide, carbon dioxide and methane.

Casey recently purchased a Varian gas chromatograph with three detectors set up for automatic injection of gas samples from gas-tight vials that will allow simultaneous detection of all three gases from samples taken at feed yards.

"We use a non-flow-through non-steady-state chamber that collects emissions off a surface, in this case manure in the pen, and we use a syringe to draw the gas sample from the air space in the chamber and then that is injected into vials for testing," Casey said.

Before the vials are filled with samples from the field, each is flushed with helium twice then evacuated, Caramanica said. When returned to the lab, those vials are placed on the gas chromatograph in an auto-sampler and samples are run through three different detectors to determine the amount of nitrous oxide, carbon dioxide and methane.

He said each sample takes approximately five minutest to test. With the

auto-sampler, they can collect 128 samples and load them in the trays for processing and then come back the next day and collate the data.

The researchers explained that samples are taken in 15-minute intervals from various locations throughout a pen: at time of chamber placement, at 15 minutes and 30 minutes to determine the buildup of emissions.

"This work area will focus primarily on nitrous oxide," Casey said.

Nitrous oxide has approximately 310 times the global warming potential of carbon dioxide, he said. It is produced as a part of the nitrogen cycle through the microbial processes of nitrification and denitrification, which are responsible for converting organic nitrogen in livestock manure and urine to inorganic forms that are absorbed and used by plants.

Casey said there are many other sources of nitrous oxide, but his study is only concerned with the feed yard. The three primary objectives of their study are:

- Detect and quantify greenhouse gas emissions from beef cattle feedlot manure management systems, especially nitrous oxide, for its greater capacity to absorb the Earth's radiative energy.
- Establish baseline flux rates of greenhouse gases produced by local feedlots.
- Help establish manure-management techniques that contribute to fewer emissions.

"We want to try to understand how much is being emitted," Casey said. "But we also expect to see a substantial variation across the feed yard

and over time, so we want to understand the mechanisms that control the emissions."

In addition to testing under wet and dry conditions, the study will be long-term to enable testing through different seasons, and then also a section of a feed yard pen pad will be lifted and taken to a greenhouse where conditions can be manipulated to determine mechanistically what is happening, Casey said.

"It may take us several years to get a reasonable handle on the mechanisms," he said. "In three to six months we will have spatial variability within the pens measured, but then we need to have the seasonal variability figured also."

Casey said their small-scale chamber work will be supplemented by collaborative work with Dr. Brock Faulkner, a Texas A&M University research assistant professor in College Station, who has an open-path Fourier transform infrared spectrometer unit.

In Faulkner's work, the spectrometer is placed at one end of the downwind edge of the feed yard and an infrared light source is placed at the other end and it measures the target gas concentrations along the path between the two, Casey said. By running both tests in the same feed yard, they can get a feel for how the results compare.

"We are part of a larger effort to quantify what emissions of greenhouse gas are from feed yards," he said. "We want to understand the variability and circumstances that create the greatest emissions and determine methodologies that identify the right numbers. Then we want to help identify management practices that can keep them at the lowest possible levels."

Provided by Texas A&M AgriLife Communications