Effectiveness of Manure Incorporation in Reducing Gas Emissions

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Introduction

Gas emissions from animal feeding operations (AFOs) detrimentally impact air quality due to short-term local effects, particularly odor, and long-term regional and global effects due to greenhouse gas emissions. Dairies in the U.S. are under increasing pressure to address air quality concerns related to manure. Planned federal, state and local environmental regulations will require animal producers to change manure management practices. The challenge, currently facing the U.S. dairy industry, is to identify manure management strategies and technologies that will help comply with environmental regulations and that are cost effective. Best management practices (BMPs) have been designed and implemented to mitigate gas emissions and assist animal producers in addressing air quality impacts from farm operations.

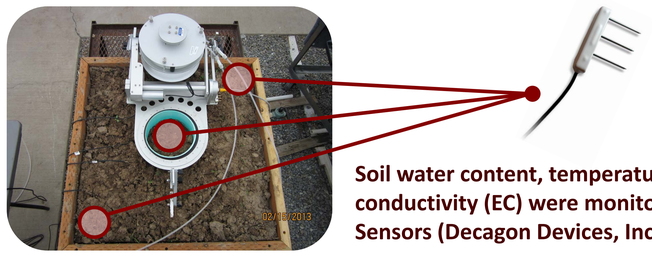
We examined an emission control strategy widely practiced at AFOs, incorporating manure immediately after surface application. The primary objectives were to evaluate the efficiency and identify improvement of the current BMPs for sustainable manure management.

Experimental Design and Setup

The experiment was conducted at the USU Research Greenhouse Complex (Logan, UT). The average day and night time temperatures in the controlled greenhouse were 33 and 19 °C, respectively. Farm yard manures (FYMs) with and without bedding material were collected from the Caine Dairy Teaching and Research Center (Wellsville, UT). In the first trial, we examined the effectiveness of manure incorporation using dairy farm yard manure without bedding material.

Closed dynamic chambers (CDC) coupled with a multiplexed Fourier Transformed Infrared (FTIR) spectroscopy gas analyzer provided gas flux estimates.

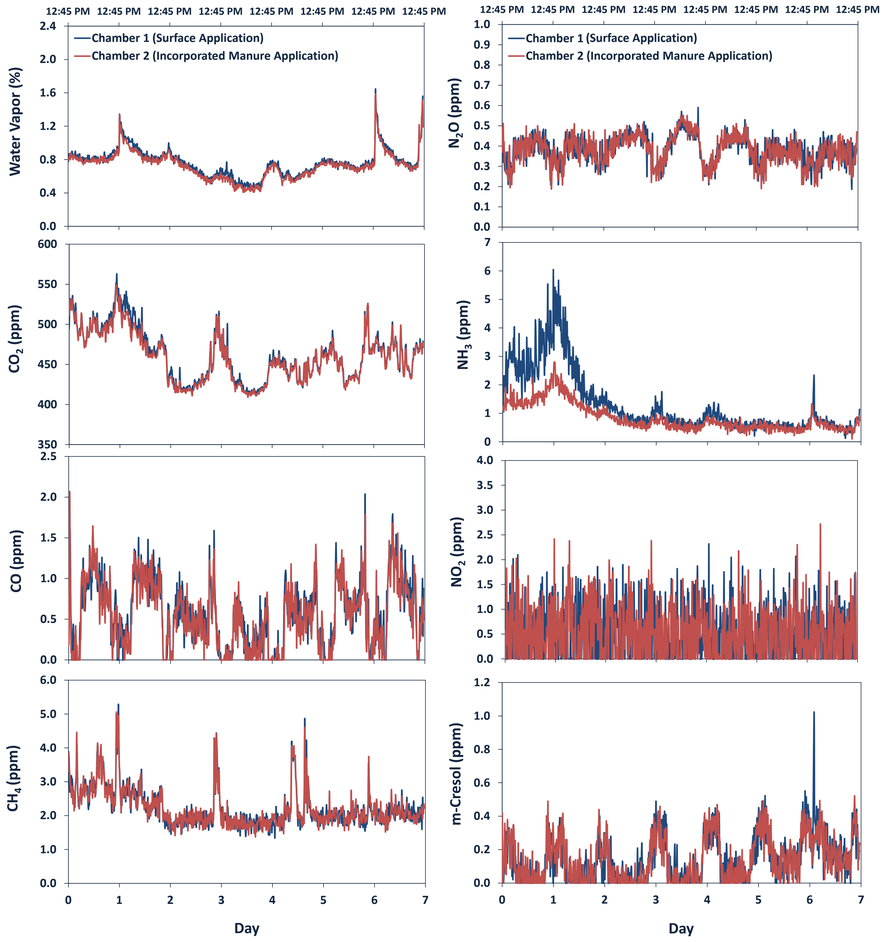
In the second trial, we investigated the effect of the bedding material (i.e. straw) added to manure on gas fluxes. The soil used in the experiment was Millville silt loam, moderately well drained with moderate permeability and medium water holding capacity. Changes in soil moisture content were monitored throughout the experiment. Under the first chamber, the manure sample was applied only on the soil surface. Under the second chamber, manure was immediately incorporated into the soil approximately four inches (10 cm) below the surface. An application rate of 50 ton/acre was used for both settings. Gas emissions were monitored using the closed dynamic chamber technique coupled with a multiplexed Fourier Transformed Infrared (FTIR) spectroscopy gas analyzer.



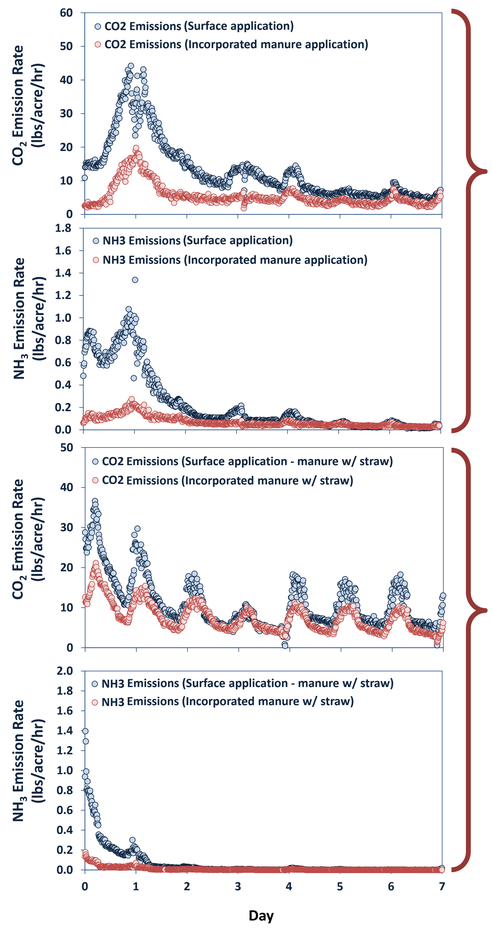
Soil water content, temperature, and electrical conductivity (EC) were monitored using GS3 Sensors (Decagon Devices, Inc., Pullman, WA).

Results and Discussion

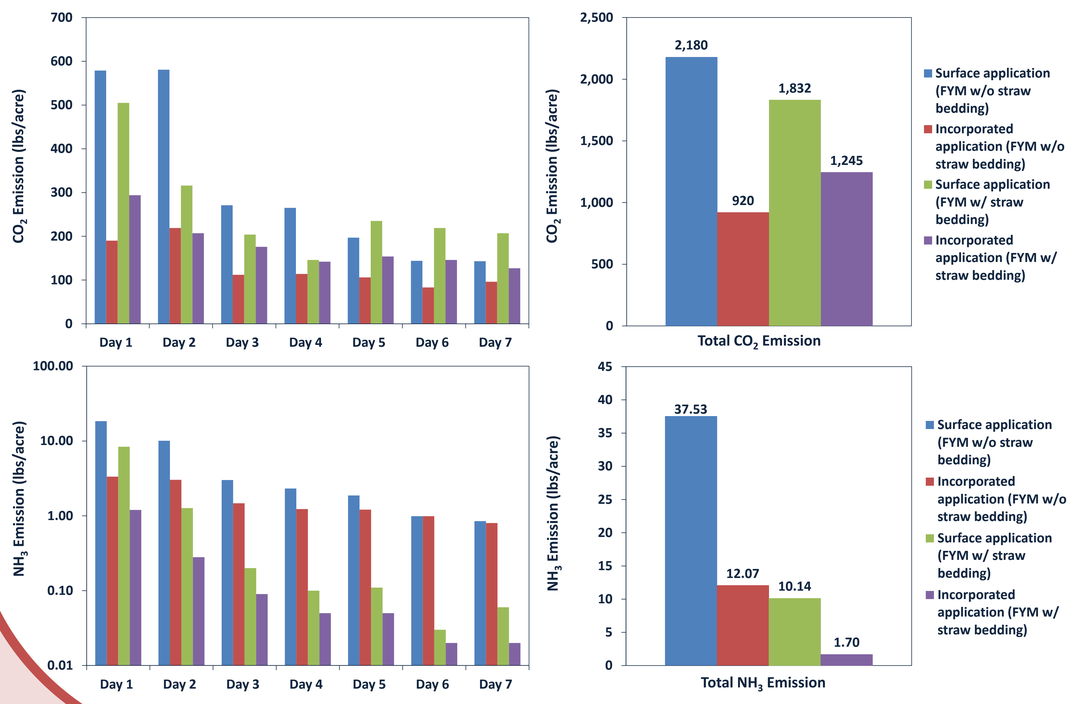
A. Gaseous Concentrations



B. Gas Flux Emissions (CO_2 & NH_3)



C. Comparison of CO_2 and NH_3 flux emissions



- The effect of incorporation on gaseous emissions was substantial in farm yard manure both with and without straw bedding material.
- Ammonia (NH_3) emissions significantly decreased when straw bedding material was added to manure in the production facility.
- Immediate incorporation may be the most effective manure management practice to reduce gaseous emissions. NH_3 emissions can be decreased up to 80% (FYM w/ bedding material) .

Acknowledgments

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