

## Gaseous Emissions Following Land Application of Manures

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## Gases of Concern

Basically the same gases considered for animal production facilities and manure storage, but differences in their impact

- > Ammonia (NH<sub>3</sub>)
- > Greenhouse gases
  - > Nitrous Oxide (N<sub>2</sub>O)
  - > Methane (CH<sub>4</sub>)
  - > Carbon Dioxide (CO<sub>2</sub>)
- > Others such as NO<sub>x</sub>'s, sulfur compounds, and volatile organic compounds

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## Ammonia

- > Large pathway for loss of crop-available N
  - >  $\text{NH}_4^+ \rightarrow \text{NH}_3$
  - > Up to 50% loss of manure NH<sub>4</sub>-N is typical
- > Contributes to smog formation
  - > Particulate matter (PM<sub>2.5</sub> regulations)
- > Source of N deposition to waterways
- > NH<sub>3</sub> volatilization
  - > Increases as soil and air temperature increase
  - > Increases as soil and manure pH increase
  - > Greatly influenced by timing and method of soil incorporation

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### Ammonia volatilization and incorporation



Broadcasting without incorporation  
➤ Greatest potential for NH<sub>3</sub> emissions



Tillage Incorporation  
➤ Can greatly reduce NH<sub>3</sub> emissions  
➤ Timing effects amount of N conserved  
➤ Not compatible with many conservation practices

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### Ammonia volatilization and incorporation



Incorporation by aeration  
➤ Less loss of residue cover  
➤ Multiple configurations/approaches  
➤ Mixed results for NH<sub>3</sub> emission  
➤ Appears to be most effective with hog manure (low solids)



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### Ammonia volatilization and incorporation



Shallow disk injection  
➤ Greatly reduces NH<sub>3</sub> emissions  
➤ Very little residue disturbance



Other types of injectors  
➤ Wide variety of designs  
➤ NH<sub>3</sub> emission usually directly related to amount of manure left on soil surface  
➤ Applicators that reduce NH<sub>3</sub> emissions generally expected to reduce odor

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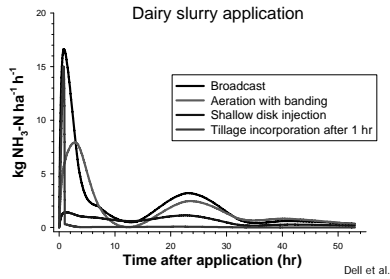
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### Ammonia volatilization and incorporation



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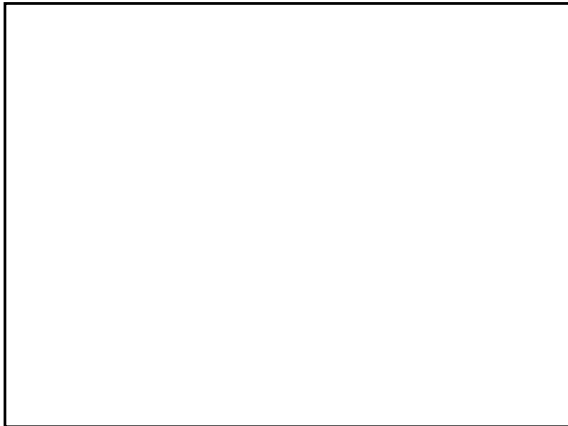
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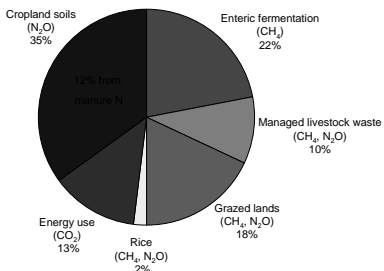
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### Agricultural Sources of Greenhouse Gas Emissions in 2005 (CO<sub>2</sub> + CH<sub>4</sub> + N<sub>2</sub>O)



USDA: U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990-2005  
([http://www.usda.gov/oce/global\\_change/AFGGInventory1990\\_2005.htm](http://www.usda.gov/oce/global_change/AFGGInventory1990_2005.htm))

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### Nitrous Oxide

- > Usually relatively small portion of manure N
  - > IPCC emission factor is 1.25% of applied N
- > Main concern is its impact as a greenhouse gas
  - > 300 times more effective than CO<sub>2</sub>
- > By-product of both nitrification and denitrification
- > Denitrification expected to be largest source
  - > Anaerobic process – controlled by soil aeration and water content
  - > Can occur in unsaturated soil when O<sub>2</sub>-depleted zones develop within soil aggregates

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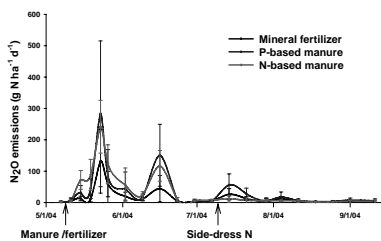
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Nitrous oxide emissions following manure (two rates) and mineral fertilizer application



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### Nitrous oxide and application method

- > Injection increases potential for N<sub>2</sub>O emission
  - > Concentrated bands of manure can promote microbial activity, which can deplete O<sub>2</sub> and create anaerobic zones
- > Limited information
  - > Three studies showed 15 to 300% more N<sub>2</sub>O with chisel injections compared to surface broadcasting
  - > 3 to 4 times greater N<sub>2</sub>O with subsurface poultry litter application when measured following rainfall simulation
- > Trade-off between reduced NH<sub>3</sub> and increased N<sub>2</sub>O must be considered

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### Methane and Carbon Dioxide

- > Land application not significant CH<sub>4</sub> source
  - > CH<sub>4</sub> emissions dissipate quickly as manure dries
  - > CH<sub>4</sub> consumption in soil offsets emissions from manure
  
- > Land application doesn't significantly impact overall CO<sub>2</sub> emissions
  - > Small in comparison to other CO<sub>2</sub> sources
  - > Manure decomposition releases CO<sub>2</sub>, but amounts not greatly effected by management and application methods
  - > Stable C compounds in manure contribute to soil C sequestration

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### New Technologies for Subsurface Poultry Litter Application

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### Auburn, Alabama subsurface litter applicator



Contact

Dr. Tom Way  
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Auburn, AL  
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### Booneville, Arkansas subsurface litter applicator



Contact

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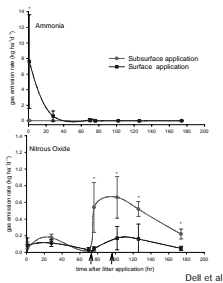
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### Ammonia volatilization and N<sub>2</sub>O emissions follow subsurface litter application



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### Up coming subsurface application research

- Chesapeake Stewardship Fund Grant
  - Penn State, Cornell, Univ. Maryland, Univ. Delaware, Virginia Tech, and USDA-ARS
  - Testing the AR applicator for subsurface poultry litter and dairy compost (N.Y.) application
  - Coupled water and air quality monitoring

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For additional information, I can be contacted at:  
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