# Why the Concern about Nitrous Oxide Emissions in Intensive Organic Production?

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## Welcome to the webinar!

- The webinar will start at the top of the hour.
- If you'd like to type in a question, use the question box on your control panel and we will read the questions aloud after the c. 45 minute presentation
- The webinar will be recorded and you can find it and a pdf handout of the slides at http://www.extension.org/pages/70280

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## Understanding and Managing Nitrous Oxide Emissions in Intensive Organic Production

Part 1:
Why the concern about $N_2O$ in organic systems?

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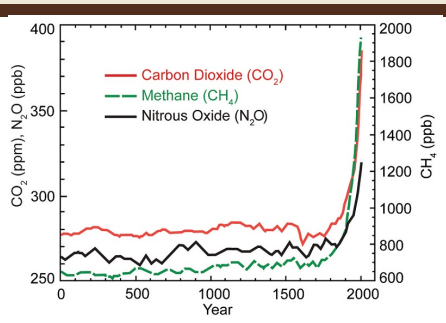
## Why the Concern About Nitrous Oxide Emissions?

- $N_2O$ as a greenhouse gas
  - Relative contribution to global warming
  - Sources
  - Role of agriculture in $N_2O$ emissions
- Nitrogen cycle and $N_2O$ production
- Why study $N_2O$ emissions in organic farming systems?
- Introduction to our experiments
- How we measure $N_2O$ emissions

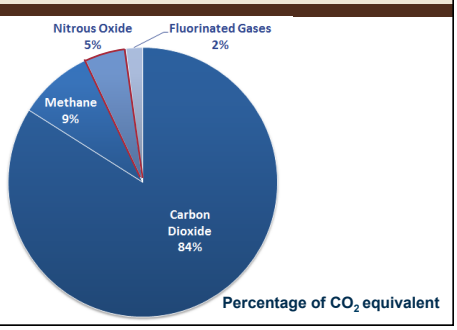
## Major greenhouse gases

| Gas | Molecule | Present Concentration (ppm) | Persistence in atmosphere | 100 yr global warming potential |
|---|---|---|---|---|
| $CO_2$ |  | 400 | centuries | 1 |
| $CH_4$ |  | 1.8 | 12 yr | 21 |
| $N_2O$ |  | 0.33 | 120 yr | 310 |
| $H_2O$ |  | varies | days | -- |

## Greenhouse gas concentrations are increasing in the atmosphere



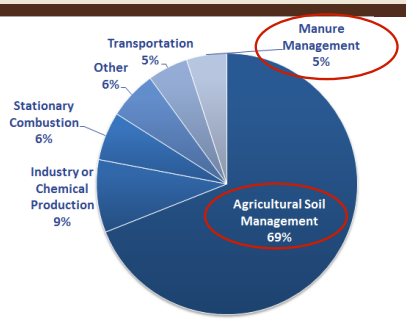

## Greenhouse gas emissions in the USA totaled 6.7 billion metric tons $CO_2$ equivalent in 2011




## Major sources of greenhouse gas emissions in the US

| $CO_2$ | Fossil fuel 94% |
|---|---|
| $CH_4$ | Fossil fuel production 41%; Agriculture 32%, Landfills 17% |
| $N_2O$ | Agriculture 74%; Fossil fuel 11% |

## Sources of $N_2O$ emissions in the US 2011

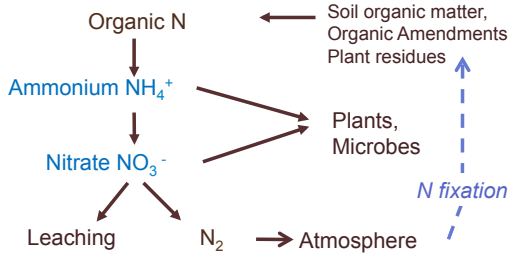



## What is the source of $N_2O$ emissions from soil?

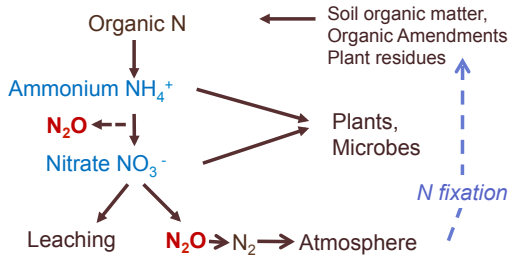
- Natural part of nitrogen cycle
- Increased agricultural N inputs have increased $N_2O$ emissions from N cycle



## Nitrogen Cycle and $N_2O$



## Nitrogen Cycle and $N_2O$

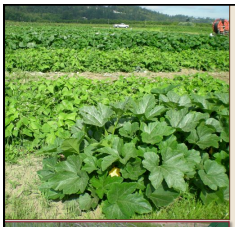



## Given all the other sources of GHG, why study organic agriculture?

- $N_2O$ is a small piece of the total emissions pie
- Organic farming is a small piece of the agriculture pie
- Tightly coupled nitrogen cycle should reduce $N_2O$ emissions

## Given all the other sources of GHG, why study organic agriculture?

- Important to understand all sources of emissions
- Organic systems vary widely in N supply from soil and amendments
- Carbon stimulates microbial activity
- Opportunity to compare among organic systems – linking management, yield, soil quality, emissions, and biology



**Long-term organic vegetable cropping systems experiment**

**2003-present**

**Organic reduced tillage experiment**

**2011-present**

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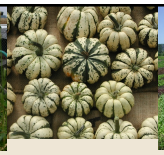
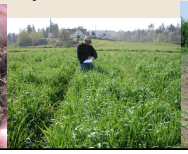



**Long-Term Organic Farming Systems Research**

Nutrient Management ⟷ Weed Ecology and Management

Soil Quality ⟷ Economics of Crop Production

Crop Yield and Quality ⟷ Insect Predators and Pests


## Three Cover Crop Treatments

| Relay planted Legume **(RLY)** | Post-Harvest Cereal & legume **(PH)** | Short-term Grass-legume Pasture **(LEY)** |
|---|---|---|



## Soil amendments include High-C compost and Low-C broiler litter.

Chicken (Broiler) litter: **(CKN)**
Low C application (1.8 - 3.1 dt/ac)

Mixed on-farm compost: **(OFC)**
High C application (8 - 17 dt/acre)



## Soil quality measurements include physical, chemical, and biological indicators

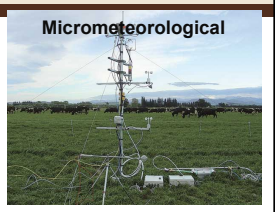
Bulk Density
Infiltration
Compaction
Particulate OM
Enzyme activity
Nematodes
Collembola
Microbial biomass
Nitrogen cycling
Microbial community structure
Nutrients and carbon

## Organic reduced tillage research using cover crop mulches.

Rolled and crimped rye

Barley terminated with flail mower (left) and roller-crimper (right)

## Gas Sampling Methods


- Measures gas accumulation over a short time in chambers
- Scale suitable for research plots
- Snapshots: may miss flux events
- Potential for soil disturbance

- Continuous measurements
- Field scale
- Expensive
- Challenging to interpret

http://www.niwa.co.nz/publications/wa/vol15-no2-june-2007/article-nitrous-oxide-the-serious-side-of-laughing-gas

## Gas collection chambers

We use the medium size, balancing area covered with ease of use.

## Chambers are made from restaurant steam table pans

Lid is made from one pan covered with insulation and fitted with a sampling port

Base is a pan with the bottom removed. Bases are left in place between tillage events.

## $N_2O$ sampled at key points throughout year

**Sampling events:**

Before and after amendment application

Before and after irrigation

Freeze-thaw

## Organic farming systems comparisons are from our research plots.

**Organic systems:**
High C (compost),
Low C (broiler litter)
Pasture

**Organic reduced till:**
Mulched vs. tilled barley

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- Find the recording and pdf handout for this webinar at http://www.extension.org/pages/70280
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- Thank you for coming!