Digestion Implications on a Livestock Operation Nutrient Profile

Cedric MacLeod

Canadian Pork Council

Don Hilborn

OMAFRA

March 11, 2006

London AD Workshop

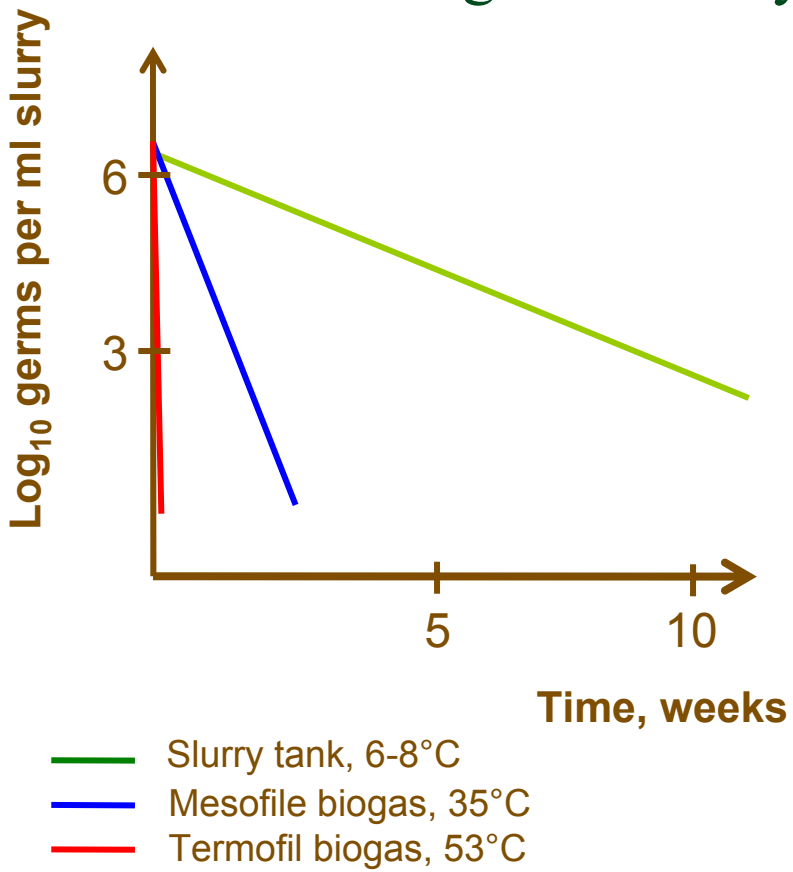
What does the Digester do to the material?

- Products of digestion are Biogas and Effluent
- Biogas contains Carbon, Oxygen, Hydrogen, Sulphur
- Crop nutrients stay in effluent
- Dry matter is partially removed
  - Klaesi Farm: 3 tests
  - 10.7% in, 8.3% out
  - 23% decrease
- Mass is reduced (1.1 kg per m^3 of biogas)
- Klaesi Farm: 3% reduction

(more) What does the Digester do to the material?

- Nutrients are converted from organic to inorganic forms
  - Example
    - Klaesi Farm
    - NH_4 1127 ppm-in, 1835 ppm-out
    - 62% increase
- Volatile Solids Removed: Odour reduced
  - Wilkie, 2000 Odour Reduction 97%
- Material Heat Treated: Pathogens reduced
  - Klaesi Farm: 3 tests
  - E. Coli 247000 MPN in, 3424 MPN out
  - 98.6% reduction
- Weed Seed viability reduced (need scientific data for this)

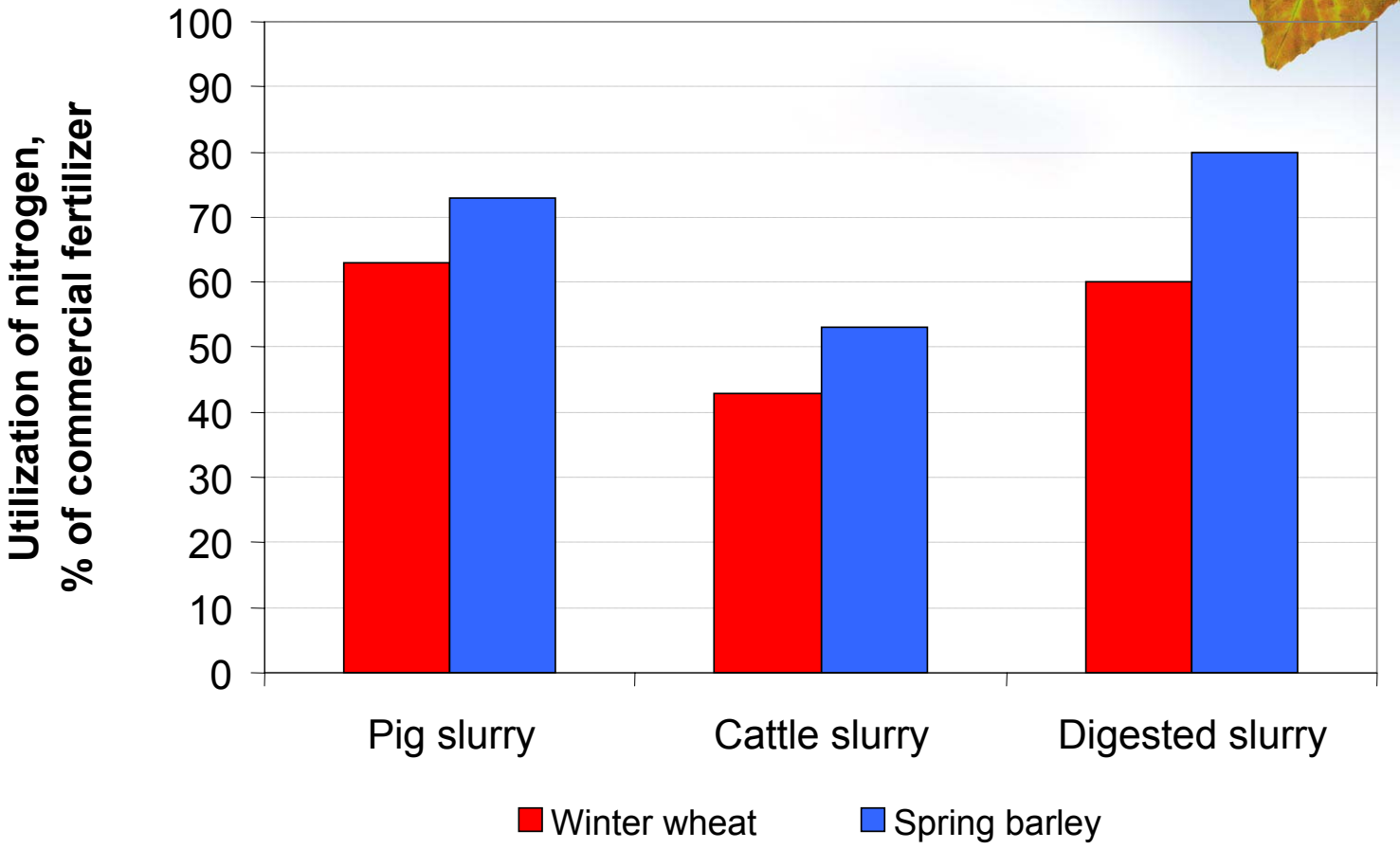
Danish Data
Digested slurry is low on germs



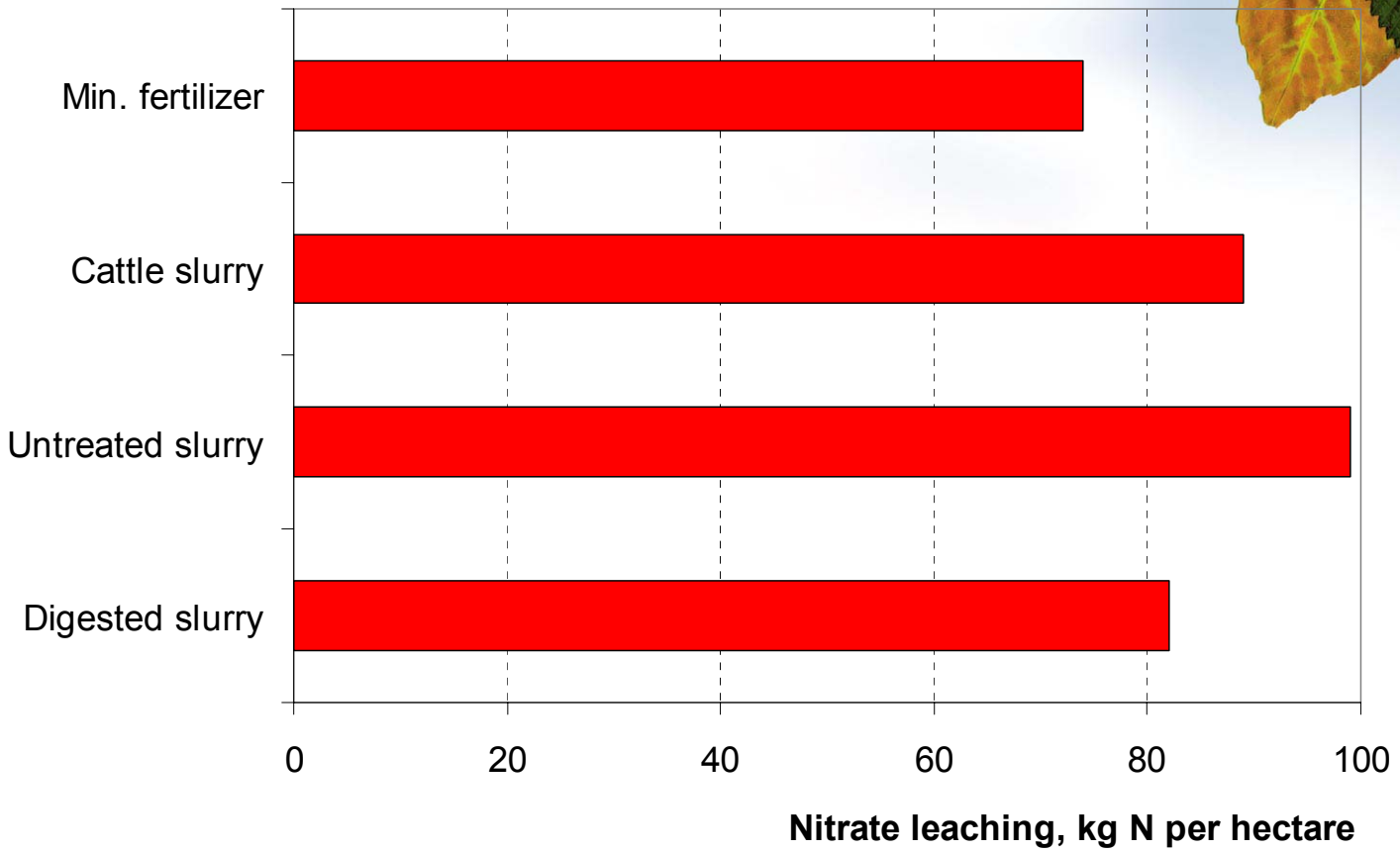
Test results from Ribe Biogas, bacteria per ml. slurry (1998)

Date	Before	After
Mar. 18	1,300,000	<5
May 13	140,000	<5
July 15	690,000	<5
Sept. 9	9,000,000	<5
Nov. 11	62,000	<5

Danish Data
Fertilizer value



Danish Data
Digestion reduces nitrate leaching



Source: Grøn Viden

Danish Rules

- **Storage capacity**
  - Cattle manure: 7 month
  - Pig manure: 9 month

- **Demands for utilization rate of Nitrogen:**
  - Cattle (*difficult): 60% N-utilization rate (Year-1) +10% (Year-2)
    - *Only obtainable when injected in the top soils on grasslands and winter cereals
  - Pigs (obtainable): 65% N-utilization rate (Year-1) + 10% (Year-2)

- Phosphorus: 25-30 kg per ha maximum application (not P_2O_5)
- Crop and field application only allowed from 1st of March until 1st of August.
- Autumn application only allowed in grass and winter oil seed rape crops

Summary of Digestion Effects

- DM is reduced
  - Easier to pump, more effective infiltration in soils?
- Volume is reduced slightly
- Plant Nutrients remain in effluent
  - No Change in land base requirement
- Nutrients switched to inorganic form
  - More readily available
  - More readily lost
- Odour and Pathogens reduced
  - May allow application in higher risk areas but same areas are commonly subject to nitrate movement which may be increased without proper management

Fitting into Ontario Process

(as suggested by the Oracle: Don)

- Current N Index addresses NH_4 increase very well
- Ideal to have some way to give credit for pathogen and odour removal
- The effect on available P is not accounted for
  - Currently NMP calculate that 40% of total P from manure is available in first year (80% available over time)
  - With digested manure this number is likely higher but there is not adequate data to indicate best number to use

Adding Off Farm Sourced Materials

- Heavy metal concerns addressed via rules
  - Must meet compost standards
- Most off farm materials have a low nutrient content so additional land for NMP will generally be small
  - Still needs to be calculated
- Heat treatment and digestion effectively lowers pathogen and nuisance issues in effluent
- Main concern if standards are followed relate to odour issues with off farm source materials prior to treatment

Adding Energy Crops

- Normally dealing with a localized crop due to high weight of desired whole plant material
- Plant nutrients conserved and should be applied back onto land where energy crops where sourced which is local due to raw material transportation issues
- 2kW per hectare of corn

Summary

- In Ontario, adequate process exist via nutrient management planning process to adequately address N in effluent
- *Increased availability of P needs to be verified and included in NMan process(if significant)*
- Advantages for pathogen and odour reduction are not given full credit
- Addition of off-farm source material and energy crops can be adequately managed