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## Characterizing Dissolved and Particulate Phosphorus in Snowmelt Runoff From Cattle Winter Bale-Grazing Sites

Barbara Cade-Menun<sup>a</sup>, Brian McConkey<sup>a</sup>, Alan  
Iwaasa<sup>a</sup>, and Bart Lardner<sup>b</sup>

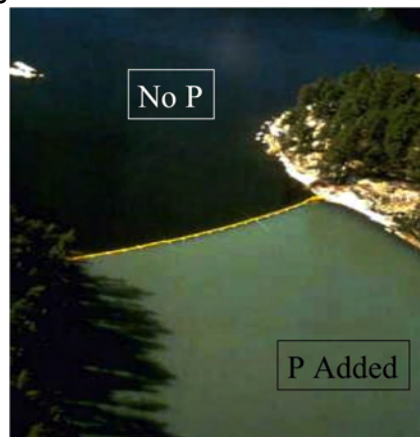
<sup>a</sup>Agriculture and Agri-Food Canada, SPARC

<sup>b</sup>Western Beef Development Centre

Canada

### Concerns about Nutrient Loss from Agriculture

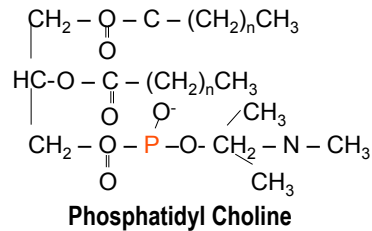
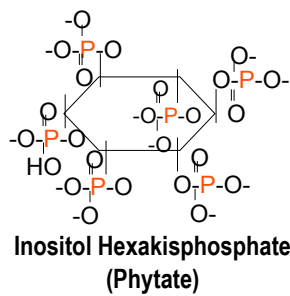
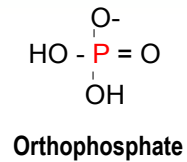
- Nutrient loss from agriculture is a concern, especially from manure
- Excess nutrients in water trigger algal blooms
- P is concern for freshwater; N in marine systems
- Nutrients can move via leaching or runoff
- Nutrients can move in dissolved or particulate forms



Lake Experiment, Manitoba, 1973

## Concerns about P Loss from Agriculture

- Particulate P and dissolved P contain a variety of P forms
- P forms differ in bioavailability and reactivity
- Understanding P forms will help to control P losses



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## Winter In-Field Bale-Grazing

- In-field winter bale grazing has become common practice in prairies, replacing winter confinement (corrals)
- Popular with producers: eliminates manure spreading/disposal; fertilizes fields; improved animal health
- However, high risk of nutrient loss during snowmelt runoff in spring (highest volume of water flow on prairies)



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## Study Objectives

### General:

- To understand nutrient movement in snowmelt runoff from in-field pasture winter bale-grazing

➔ Does in-field pasture winter bale-grazing change the forms and concentrations of nutrients in snowmelt runoff?

### Specific:

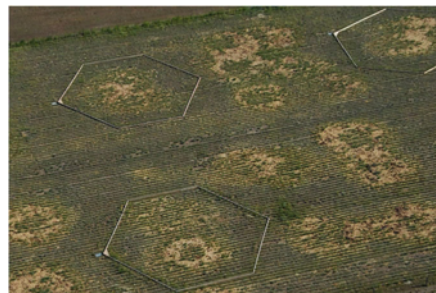
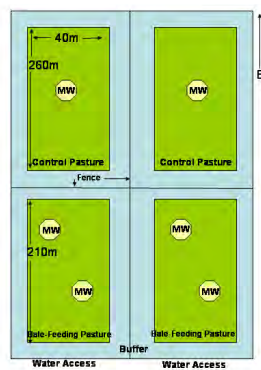
- To quantify particulate and dissolved P in snowmelt runoff from in-field pasture winter bale-grazing

➔ Can we identify and quantify specific dissolved and particulate P forms in snowmelt runoff?

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## Study Site Set Up

- Microwatersheds (MWs), each 0.353 m<sup>2</sup>, constructed with flume at down-slope position
- Four treatments (bales placed at different times), 2 controls
- Russian wild rye pasture
- Cattle on pasture November 17-March 3



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## In-Field Winter Feeding



- Density: 2000 cow days ha<sup>-1</sup>
- Bales in MWs Jan. 16-18 and Feb. 15-17
- Snowmelt events Mar. 3-4 and Mar. 14-17

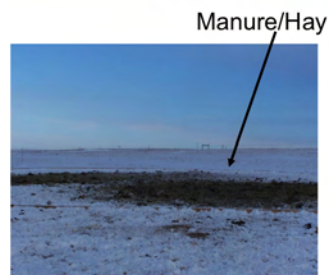
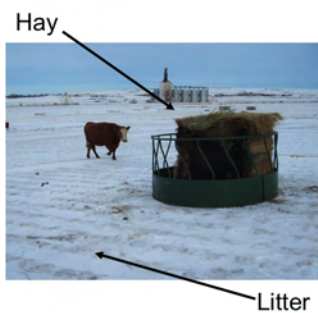


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## Sample Collection



Runoff samples hand-collected (1-l samples 3 times daily; 5-l samples when available)

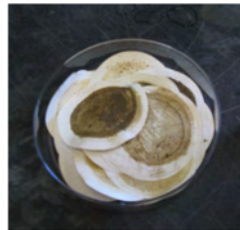


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## Sample Preparation



- Runoff Water
  - Filtered (0.45- $\mu$ m GFF)
- Litter, Hay, Manure/Hay
  - Dried, ground
- Filtrate
  - Frozen, freeze-dried



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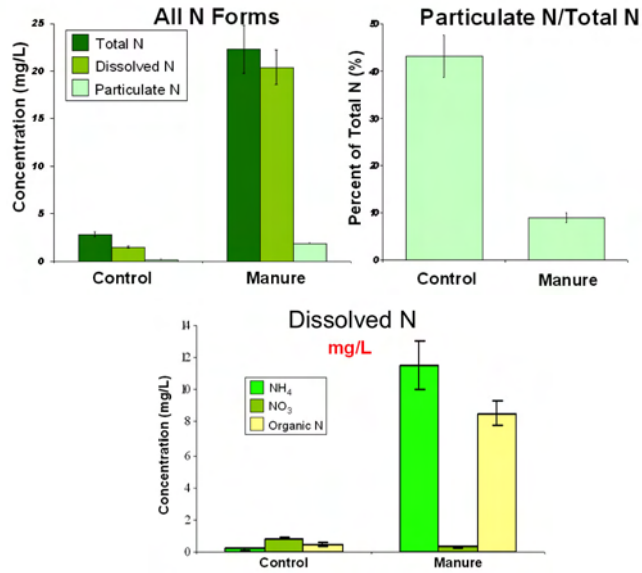
## Sample Analysis



- Particulates
  - Total C, total N, total P
- Filtrate
  - Total dissolved P, N, total organic C
  - Nitrate, ammonium, reactive P
- Litter, Hay, Manure/Hay
  - Total P, total N
- All Sample Types
  - P forms via solution  $^{31}\text{P}$  NMR spectroscopy

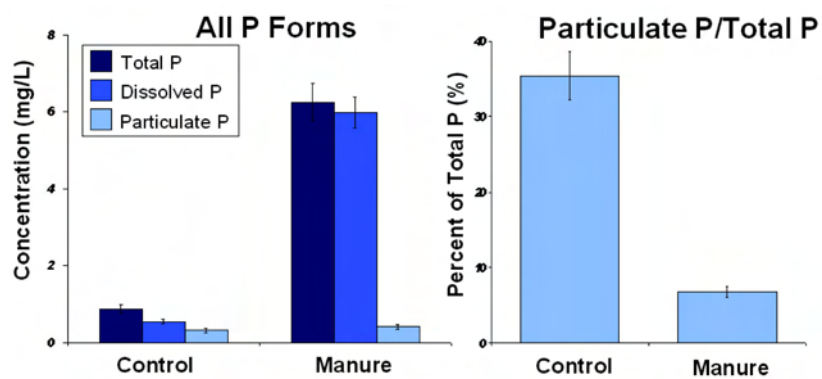
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## Runoff Nitrogen



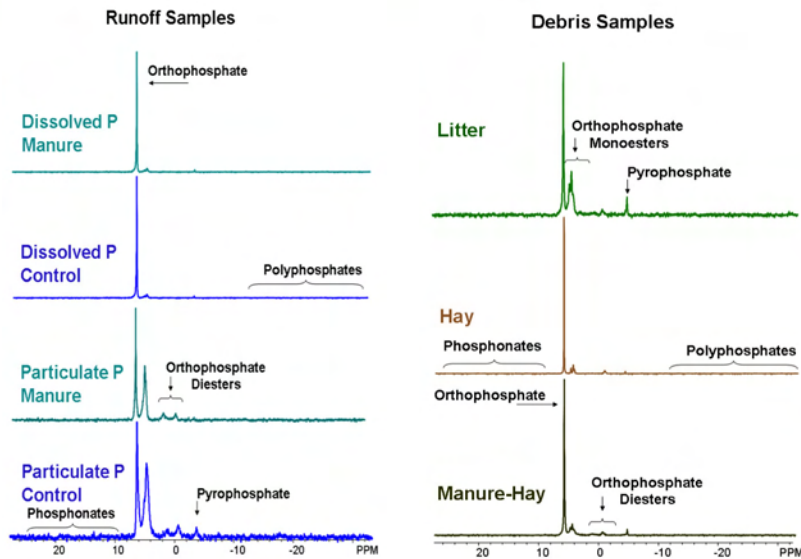
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## Runoff Dissolved and Particulate P



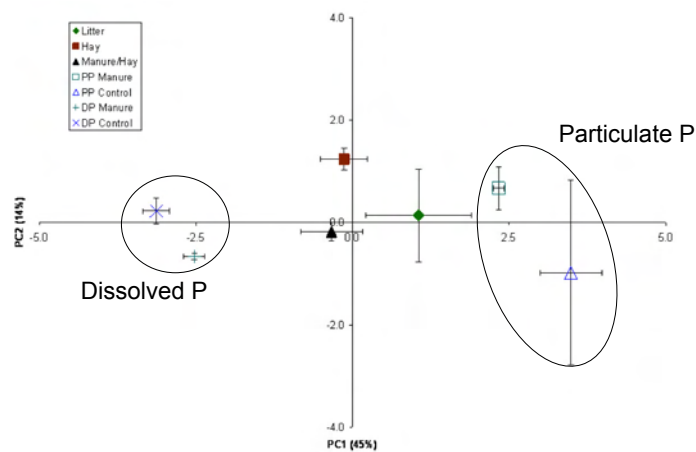
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## <sup>31</sup>P NMR Spectroscopy



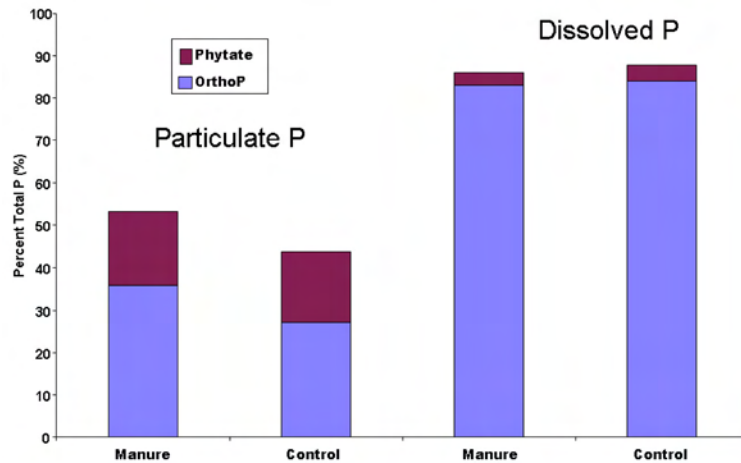
## Specific Phosphorus Forms

Principal Components Analysis: converts spectra with multiple P forms to single point



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## Specific Phosphorus Forms



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## Summary

- Does in-field winter bale grazing change nutrient forms and concentrations?
  - Yes, different N and P forms were observed in samples from control and bale-fed sites
- Can we characterize P forms and quantities in snowmelt runoff?
  - Yes, we can clearly identify a variety of P forms in dissolved and particulate samples, and were able to compare these to debris materials collected after bale-grazing
  - Dissolved samples contained mainly orthophosphate, while particulate samples contained more organic P forms

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## Continuing Research

- This is first year of 3-year study, so no conclusions yet
- Soil samples collected; analysis underway

2009-2010:

- Added another control in fall 2009 – manure spread at same P loading rate as bale-feeding;
- Bale-fed on different pastures (crested wheat grass); collected run-off from new microwatersheds (including new controls), previous controls, and microwatersheds bale-grazed in 2008/2009
- Longer, steadier runoff period; flow rates monitored more frequently; more water samples collected

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