



Achieving P Balance:

Research at the University of Manitoba and the National Centre for Livestock and the Environment (NCLE)

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What is NCLE?

The National Centre for Livestock and the Environment (NCLE) is a multi-disciplinary research team dedicated to linking livestock systems with cropping systems to improve the sustainability of both systems.



Manure P Research Within and Across Disciplines

- **Characterization of P in**
 - **Feed Ingredients, Manure and Soil**
 - Form and availability of P, concentration
 - Complex interactions with other constituents
 - Other considerations (dietary requirements, soil's capacity for retention, etc.)

Nyachoti – feed and manure

Akinremi – soil and manure

Kumaragamage and Flaten – manure and runoff



Research

Within and Across Disciplines

- Bigger picture – what is happening with P at a systems level?
- **Achieving P balance depends on:**

- Feed management

- In-field management

- Manure management and treatment

Each is an important component of the whole system

Feed Management for P Balance

Increase P utilization efficiency

- Most practical solution in the short term is to match supply with requirements
 - Total P for ruminants
 - Available P for non-ruminants



Minimizing excess P in manure

- benefits of phytase, hulless low phytate barley, phase feeding
- balancing available P sources in diet
- interactions with other nutrients (Ca)
- risk of excess P from DDGS
- bioavailability in alternative feed ingredients

Feed Management for P Balance

Matching supply with requirements:

Increasing available P in pig diets:

- High Available Phosphorus (HAP) Barley increases P digestion & reduces P excretion
- Adding phytase to pig diets reduces P excretion

Balancing available P in pig diets:

- Adding phytase and reducing dical = less P excretion

Phase feeding pigs:

- Decreases feeding costs and P excretion
- Reduces required P by 4.18 tonnes for 10K pigs

Feed Management for P Balance

Phase Feeding Decreases Feeding Costs and P Excretion

	Grower 1	Grower 2	Finisher
~Feed usage, kg/pig	70.2	87.0	109
Needed P - No Phase Feeding, kg P/pig	0.421	0.522	0.654
Needed P - With Phase Feeding, kg P/pig	0.351	0.392	0.436
Difference, kg P/pig	0.070	0.130	0.218
Reduces required P by 4.18 tonnes for 10K pigs			

(Nyachoti, U of M)

Modelling Tools for Managing and Predicting Dietary P Balance

Diet formulation and nutrient management planning to meet dietary requirements while managing for P balance

- How does diet impact nutrient composition of manure?
 - Evaluation of models in use
 - Improvement of existing models
 - Development of new models



In-Field Management for P Balance

- Long term field laboratory at Glenlea Research Stn.
- Solid cattle manure studies at Brandon, Argyle, Lake Francis, Carman and Glenlea
- La Broquerie Project



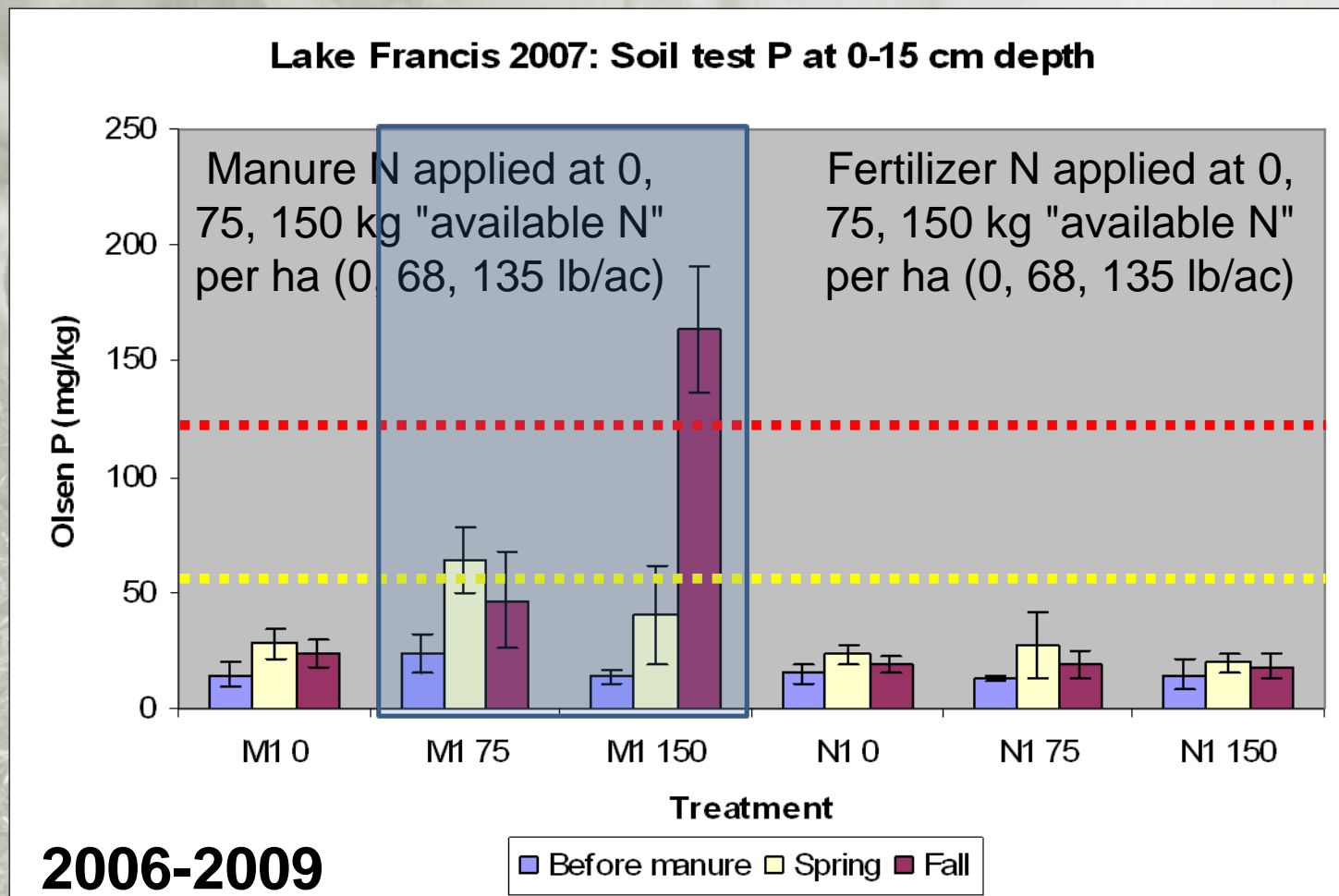
NCLE Long Term Manure and Crop Management Field Trial



- 96 plots
- 2 cropping systems: annual and perennial
- 12 nutrient management treatments:
 - Control (no manure or synthetic fertilizer)
 - Synthetic fertilizer to meet crop N and P requirements
 - Liquid pig manure at 2 rates: N- and P-based
 - Stockpiled solid pig manure at 2 rates: N- and P-based
 - Stockpiled solid dairy manure at 2 rates: N- and P-based
 - Four treatments for future
 - Composted solid pig manure at 2 rates: N- and P-based
 - Liquid effluent and solid byproduct

Solid Beef Cattle Manure Project

At high N rates, cattle manure increases soil test P concentrations in surface soil



Fertilizer Equivalence of Different Manures

How accurate are traditional estimations of N mineralization rate for manure?

- To date results from the NCLE LT trial and the Solid Cattle Manure study show slower release than estimated
- What does this have to do with P balance?
 - Slower N release = Higher rates of manure P application at N-based rates

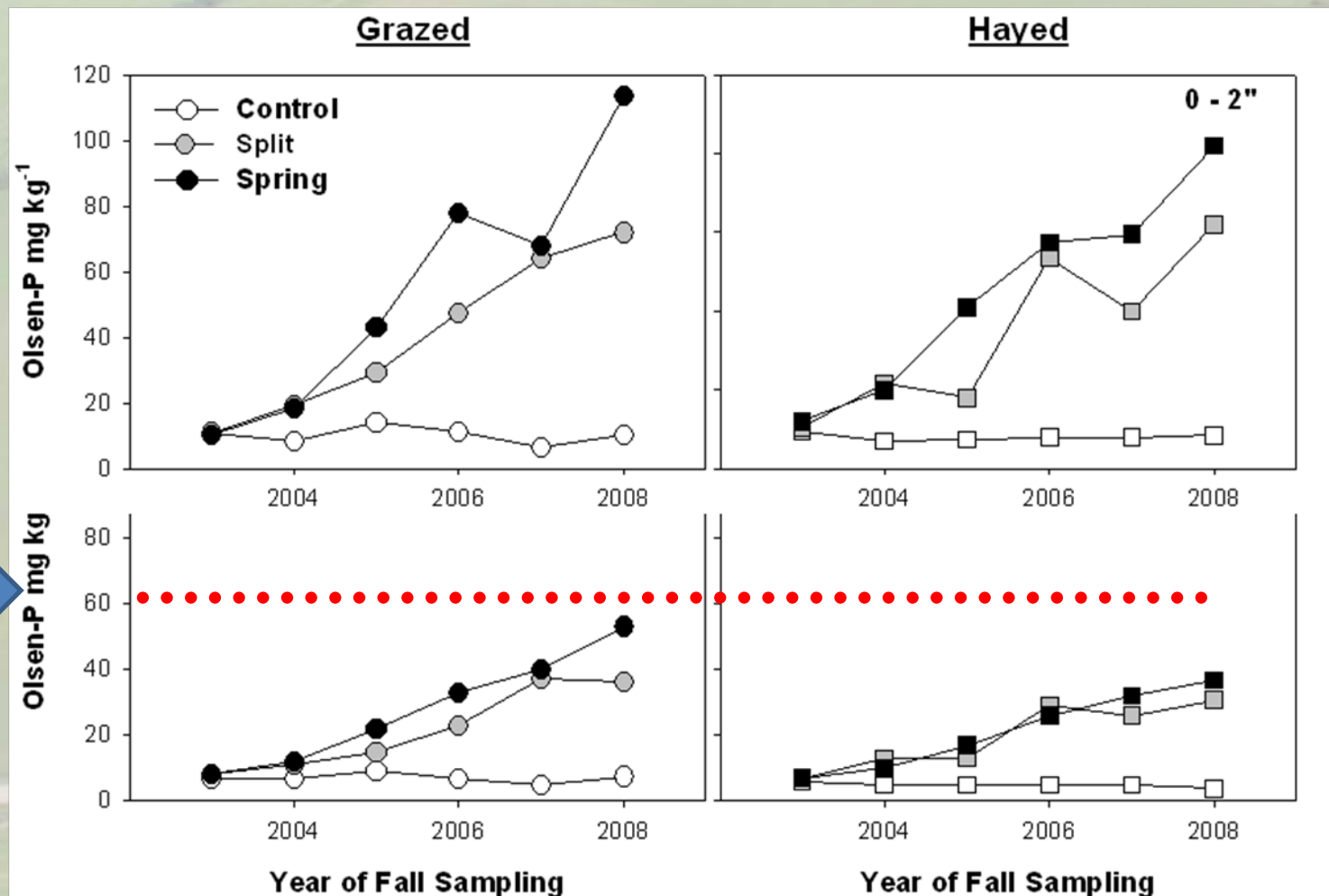
The La Broquerie Long Term Project

Pig Manure on Perennial Forage

Kim Ominski, Mario Tenuta and many others

- 98 acres Southeast Manitoba (La Broquerie)
 - Coarse textured soil
- Liquid Pig Manure application timing
 - Control (no pig manure)
 - Split application = 55 lbs N/ac (fall and spring)
 - Full application = 110 lbs N/ac (spring)
- Forage Utilization Systems
 - Baled as hay
 - Grazed by cattle
- Fall 2003 – present

The La Broquerie Long Term Project Soil Test P Levels (2003-2008)



2x P removal

The La Broquerie Long Term Project Cattle & Forage Productivity (2004-2006)

Nutrient removal efficiency for the two fertilized systems (% of applied nutrient)

	Grazed pasture system		Hayed system	
	<u>Split</u>	<u>Full</u>	<u>Split</u>	<u>Full</u>
N	5%	5%	33%	32%
P	6%	4%	25%	19%

Next Steps:
Optimal forage management for P drawdown?

- P removal and export as a product with end use market

Whole Farm Nutrient Balance

Reducing whole-farm surpluses of P and K: inputs, on-farm cycling and exports on Manitoba dairy farms

Accumulation of P and K must be avoided due to:

- Shift from N- to P-based manure management regulations
- Health problems caused by a high K contents of forages

Objective:

Develop beneficial management practices (BMPs) that reduce on-farm accumulation of surplus P & K

Manure Treatment

- Anaerobic digestion of liquid pig manure
- Recovery of liquid pig manure P as struvite (MgNH_4PO_4)
 - digested manure – bench scale
 - uncovered EMS – pilot scale
 - covered EMS – commercial scale
 - How to remove more P as struvite...within existing manure storage set ups
- Future research
 - solid-liquid separation
 - composting



Economics of Achieving P Balance

What are the options and what are the costs?

- **Completed (2007): Economic Assessment of the New Environment Regulations for the Pig Industry in Manitoba**
- **Current: Viability of Manure as a Nutrient Source on Manitoba Farms**
- **Member of new federally funded Agriculture - Environmental Policy Research Network (ERCA)**

Achieving P Balance – How Can NCLE Help?

– Research Teams

➤ NCLE has resources dedicated to bringing together researchers on a project-specific or program basis

– Partnerships and collaborations

➤ Working to ensure research addresses needs of livestock industry

– Infrastructure

➤ We have capacity for systems level research for all the major livestock species– and are working to fill gaps

– Communication

How Can NCLE Help?

Extension & Technology Transfer

- **Tours & Field Days** - a variety of industry, government and special interest groups
- **Discussions & Special Sessions** - for sharing information and building partnerships and collaborations
- **Down the Road...What we see...**
 - classes in the education centre?
 - specialized training sessions?



Questions?

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