Agronomic application of cattle manure and compost on irrigated cereal silage

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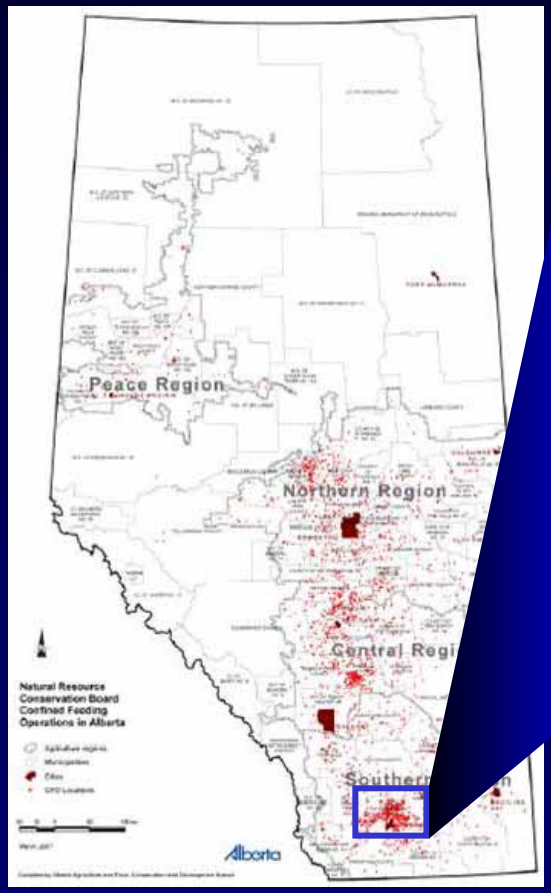
Irrigated Crop Production Update 2010
January 11-10, 2010
Lethbridge, Alberta

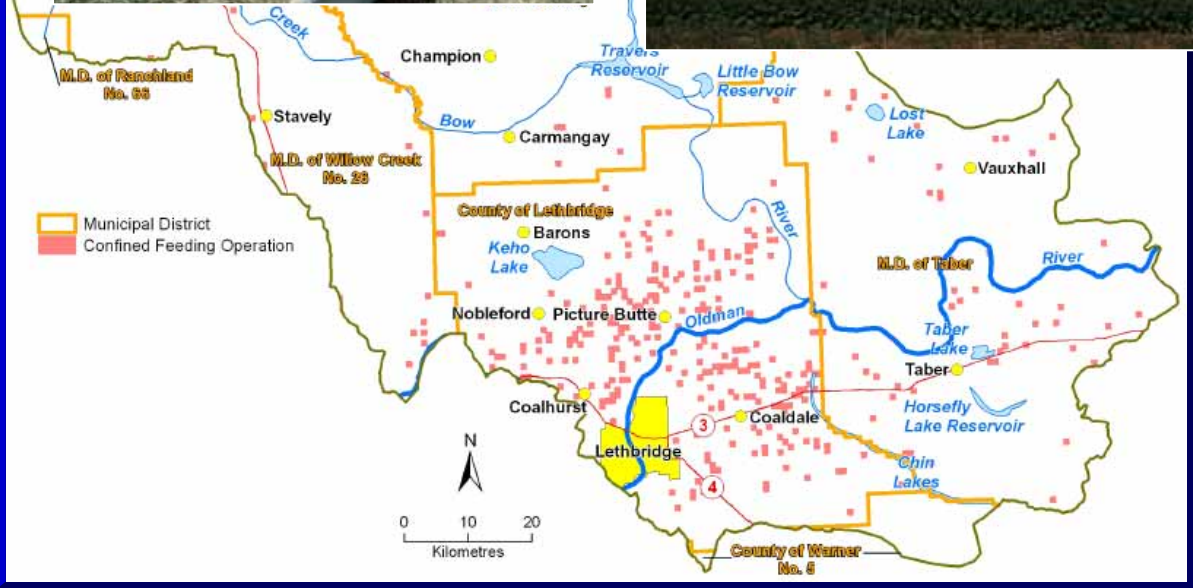
Introduction

Nutrient management and application are required for optimum crop production.

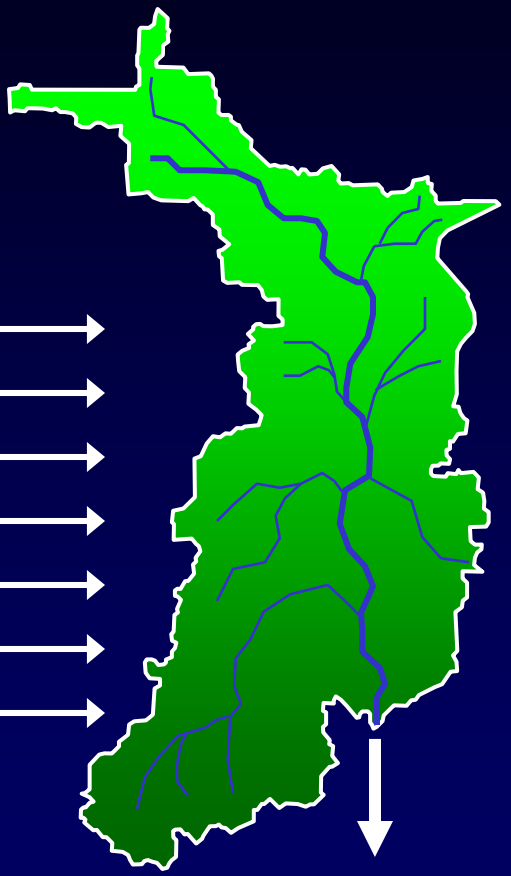
Loss of nutrients from agricultural systems is a major environmental concern.

Intensive Agriculture





Nutrient budgets



Imports

- forage
- grain
- livestock
- fertilizer
- legume N_2 fixation
- manure
- atmospheric deposition

Exports

- crop products
- livestock
- manure

N surplus
P surplus

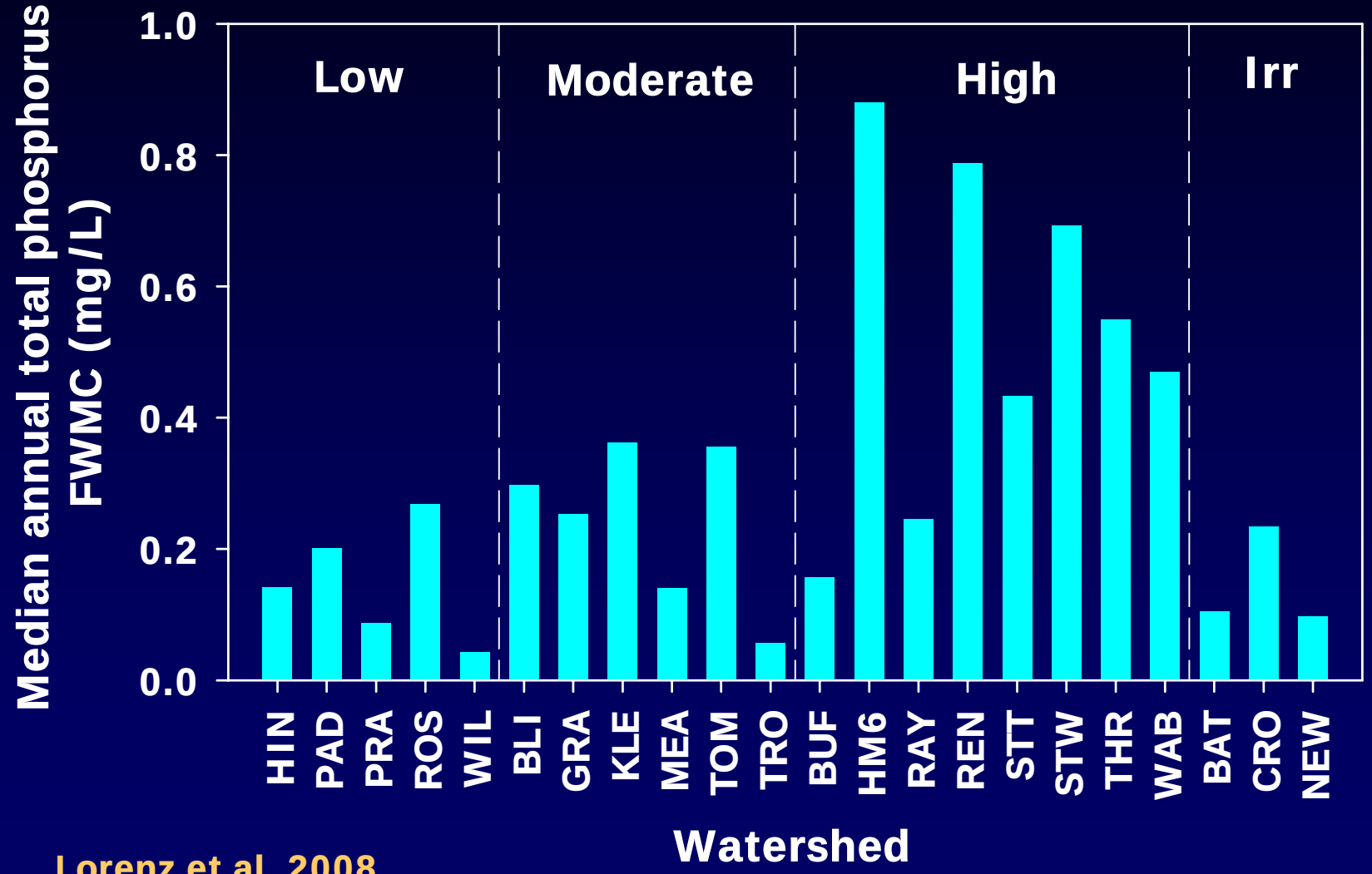
water quality impairment

Eutrophication

Is the natural process of lake aging, but can be accelerated by human activity.

- nutrient enrichment (P)
- extensive plant growth and decay
- reduced oxygen and cause fish kills
- toxicants from algae blooms
- restricts flow
- odour and poor esthetics

Alberta Environmental Sustainable Agriculture Water Quality Monitoring Project (1999 to 2006)



Lorenz et al. 2008

Approach: Nutrient management planning

Soil and manure sampling

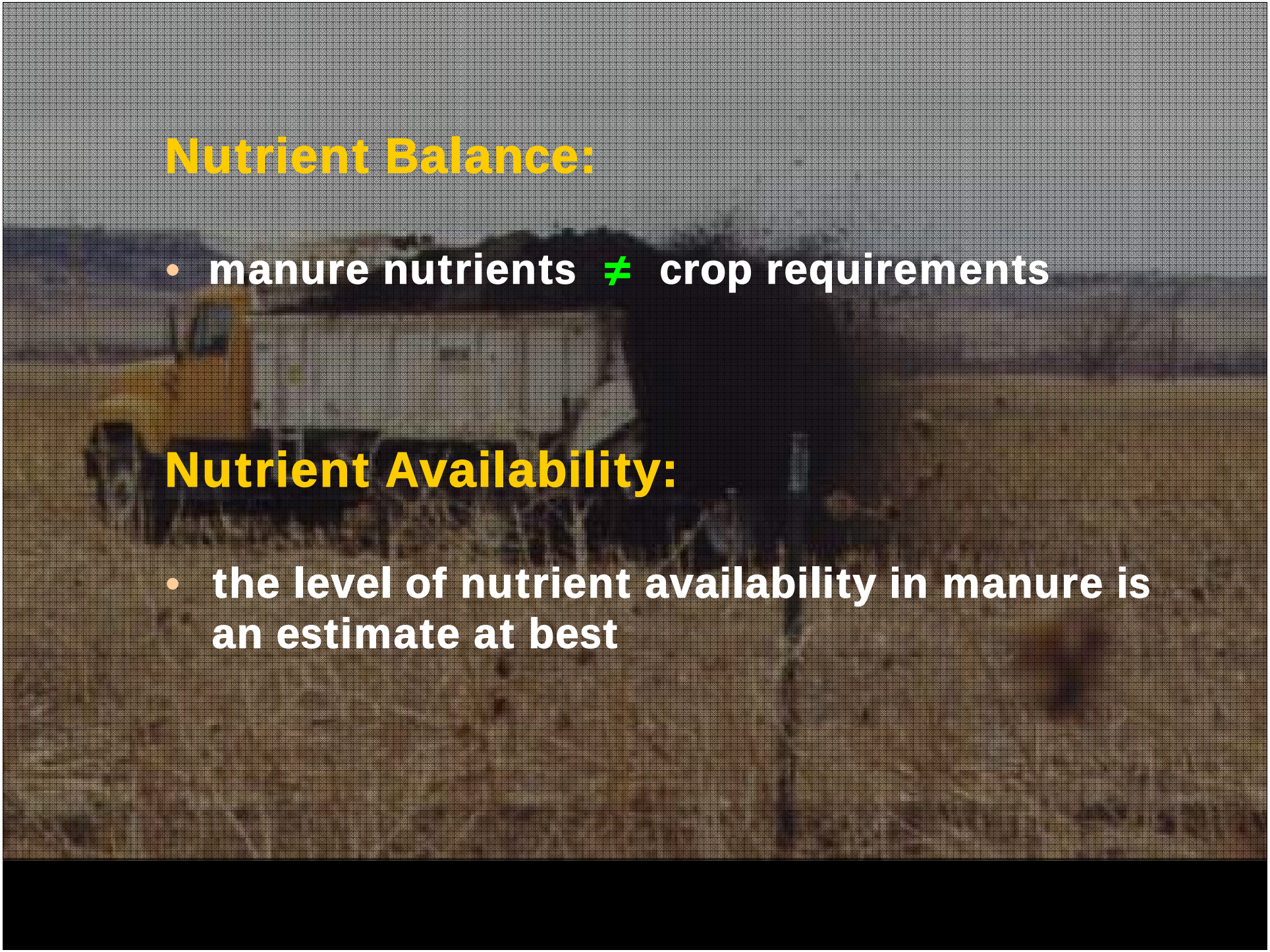
Lab analysis

Nutrient application

Keep records

Feed testing & ration planning

Crop rotation



Nutrient Balance:

- manure nutrients ≠ crop requirements

Nutrient Availability:

- the level of nutrient availability in manure is an estimate at best

Agronomic manure application study

Objectives

- **Examine the effects of nitrogen-based and phosphorus-based application of fresh and composted cattle manure on soil chemistry and crop yield.**

- **Assess the nutrient management approach to applying organic sources of nutrients.**

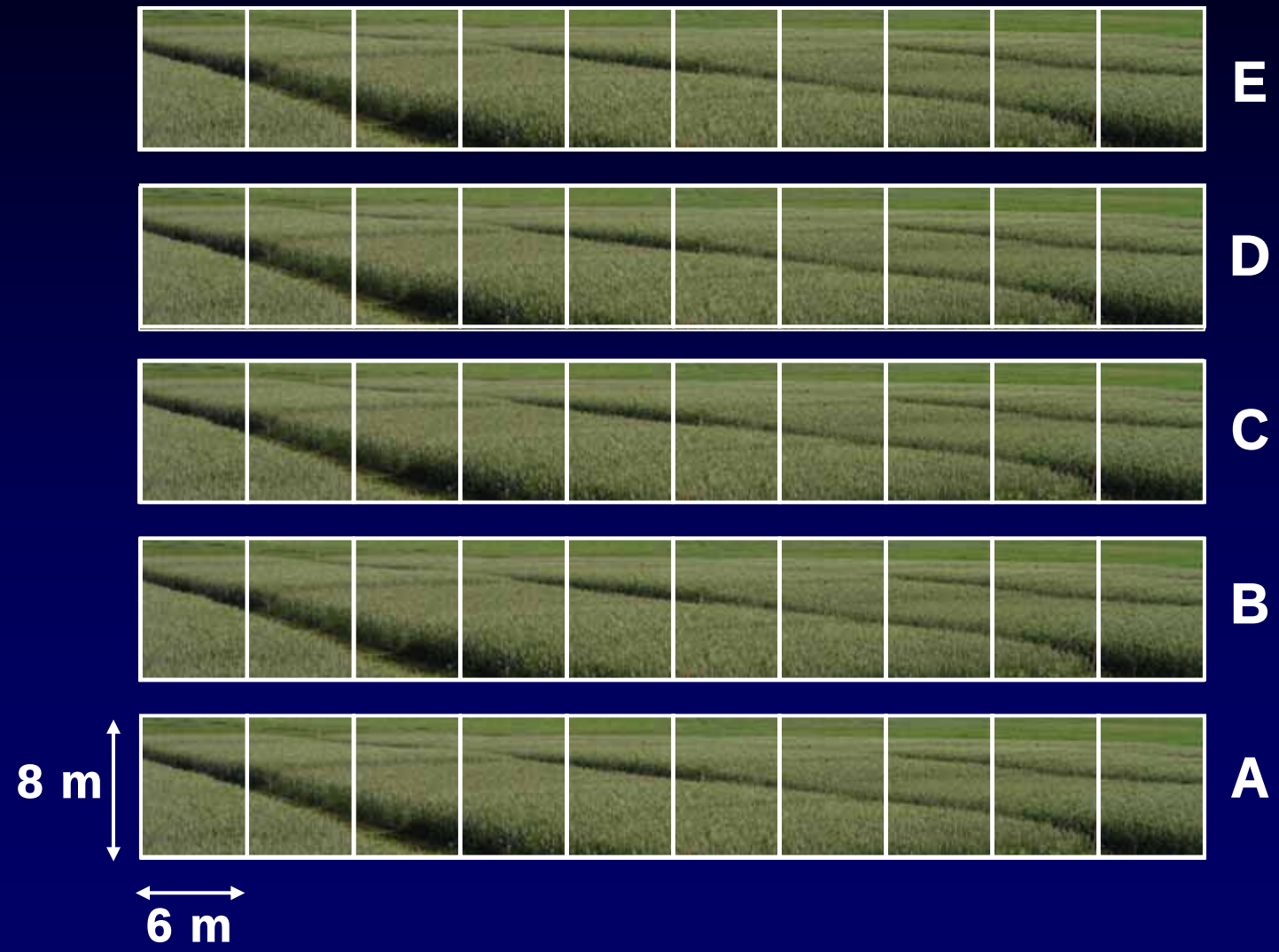
Field site

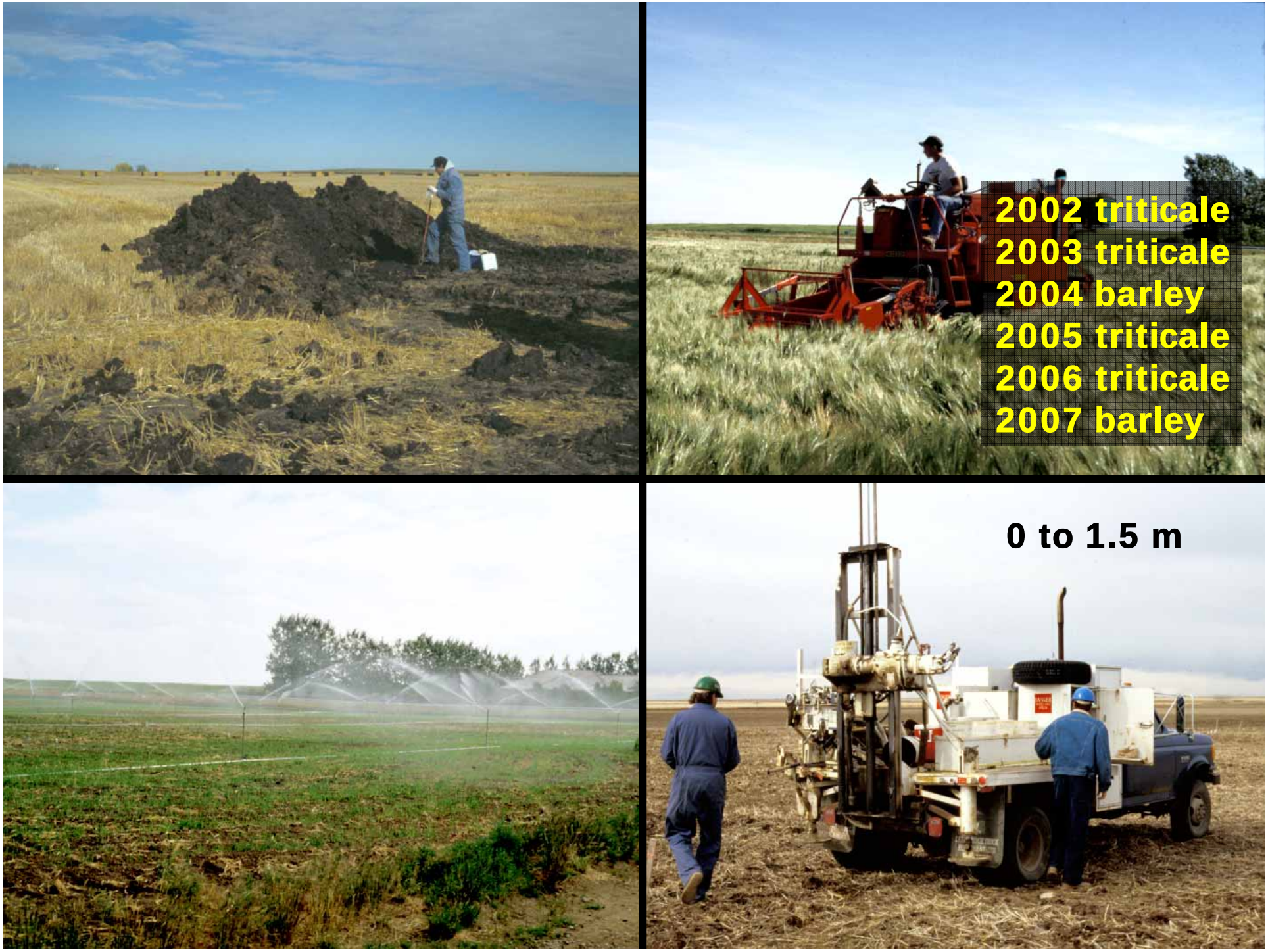

Calgary
British Columbia
Lethbridge
N
Alberta
United States of America
CACDI
CANADA-ALBERTA
CROP DEVELOPMENT INITIATIVE
LETHBRIDGE DEMONSTRATION FARM
Partnering with the Agriculture Industry
to Develop Innovations Today
for Tomorrows Future...
Canada
Alberta
THANKS TO OUR INDUSTRY PARTNERS
Dark Brown Chernozemic
Medium textured soil

Experimental treatments

- Control
- N fertilizer
- P fertilizer
- N + P fertilizer
- N-based manure
- P-based manure (+ N fertilizer)
- 3 x P-based manure / 3 yr (+ N fertilizer)
- N-based compost
- P-based compost (+ N fertilizer)
- 3 x P-based compost / 3 yr (+ N fertilizer)

Field site: 2001-2007




2002 triticale
2003 triticale
2004 barley
2005 triticale
2006 triticale
2007 barley
0 to 1.5 m

Application rates

Nutrient application rates were based on annual fall soil testing and fertilizer recommendations.

Inorganic nutrient sources

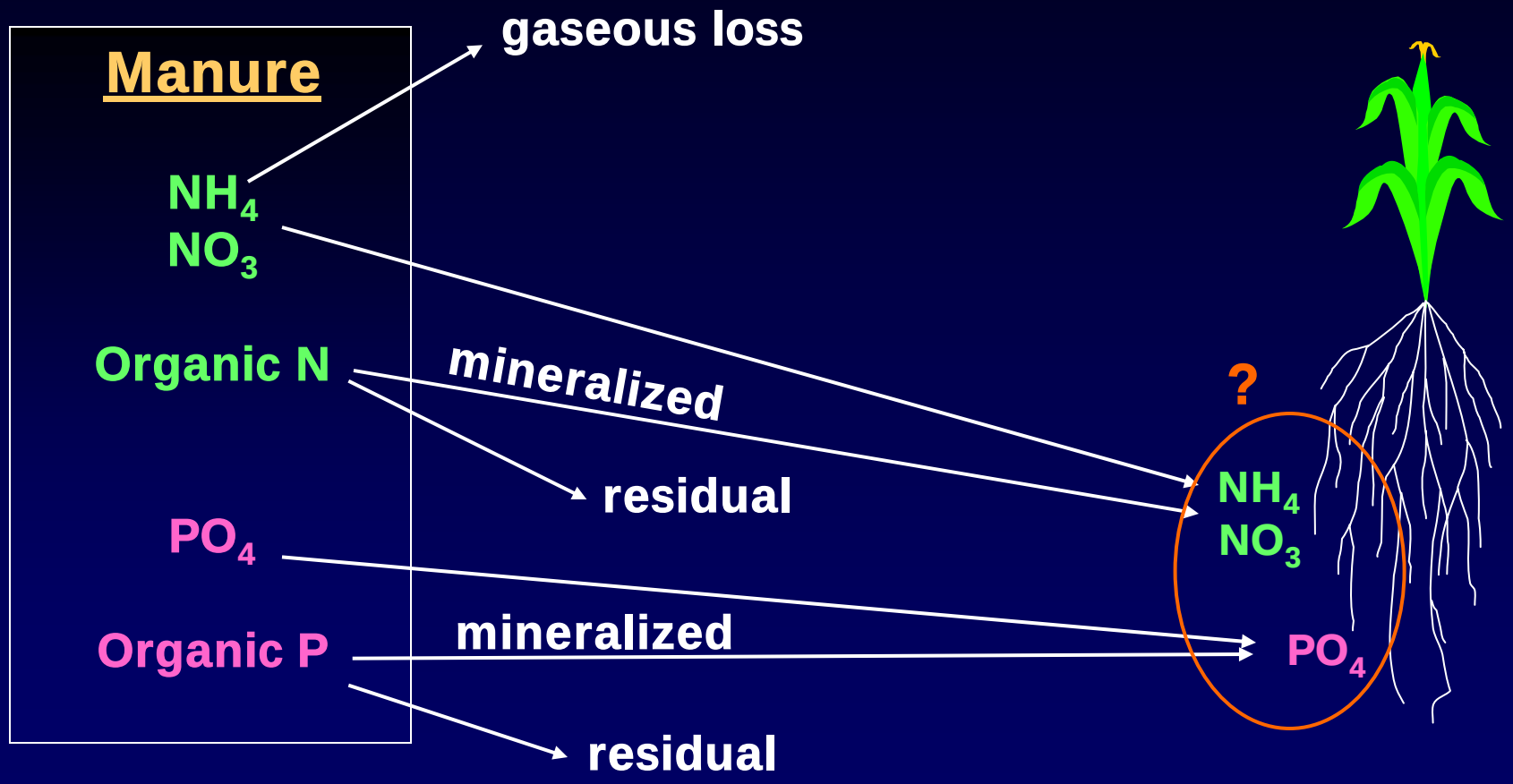
Fertilizer nitrogen

46-0-0 (urea; pre-seeding, spring banded)

Phosphorus fertilizer

0-45-0 (with seed)

Crop available N and P in manure



Manure nitrogen and phosphorus

	Year 1	Year 2	Year 3
	% available nitrogen*		
Manure	25	13	7
Compost	13	7	4
	% available phosphorus**		
Manure	70	20	10
Compost	60	15	8

*as a % of the original amount of organic N applied
**as a % of the original amount of total P applied

Eghball and Power 1991; Eghball et al. 2002; Sharpley and Moyer 2002

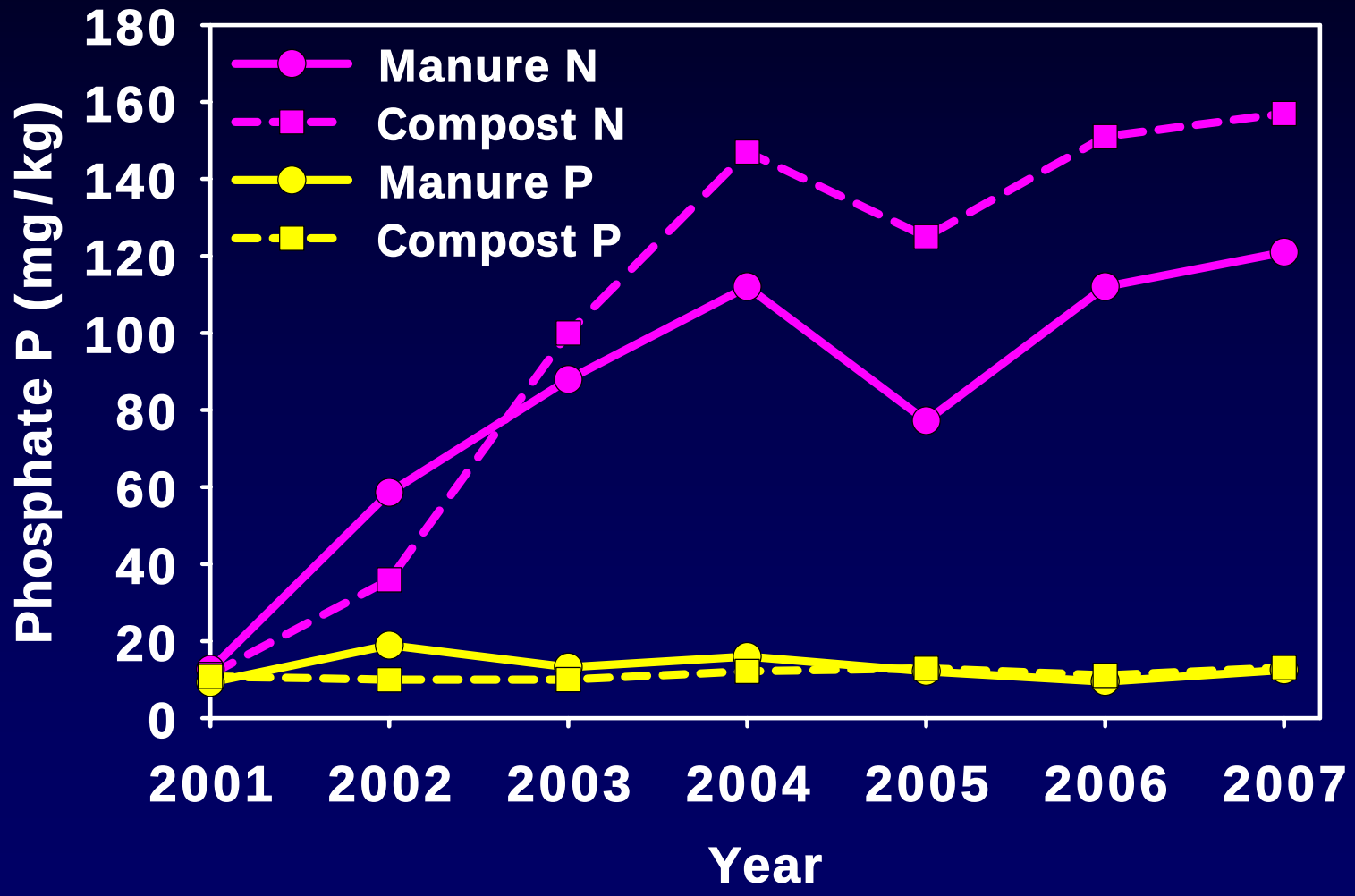
Soil nitrate-N (0-60 cm)

	Cont	FN	FP	FNP	MN	MP	MP3	CN	CP	CP3
	---------- mg/kg ----------									
2001	13	16	20	19	14	14	15	17	16	21
2002	3	3	2	2	4	3	3	3	2	3
2003	3	8	3	7	7	8	9	7	8	7
2004	1	8	1	5	4	5	6	8	5	5
2005	2	3	2	3	2	3	3	3	3	3
2006	1	6	1	7	3	5	6	4	7	5
2007	1	10	1	11	4	7	6	5	9	8

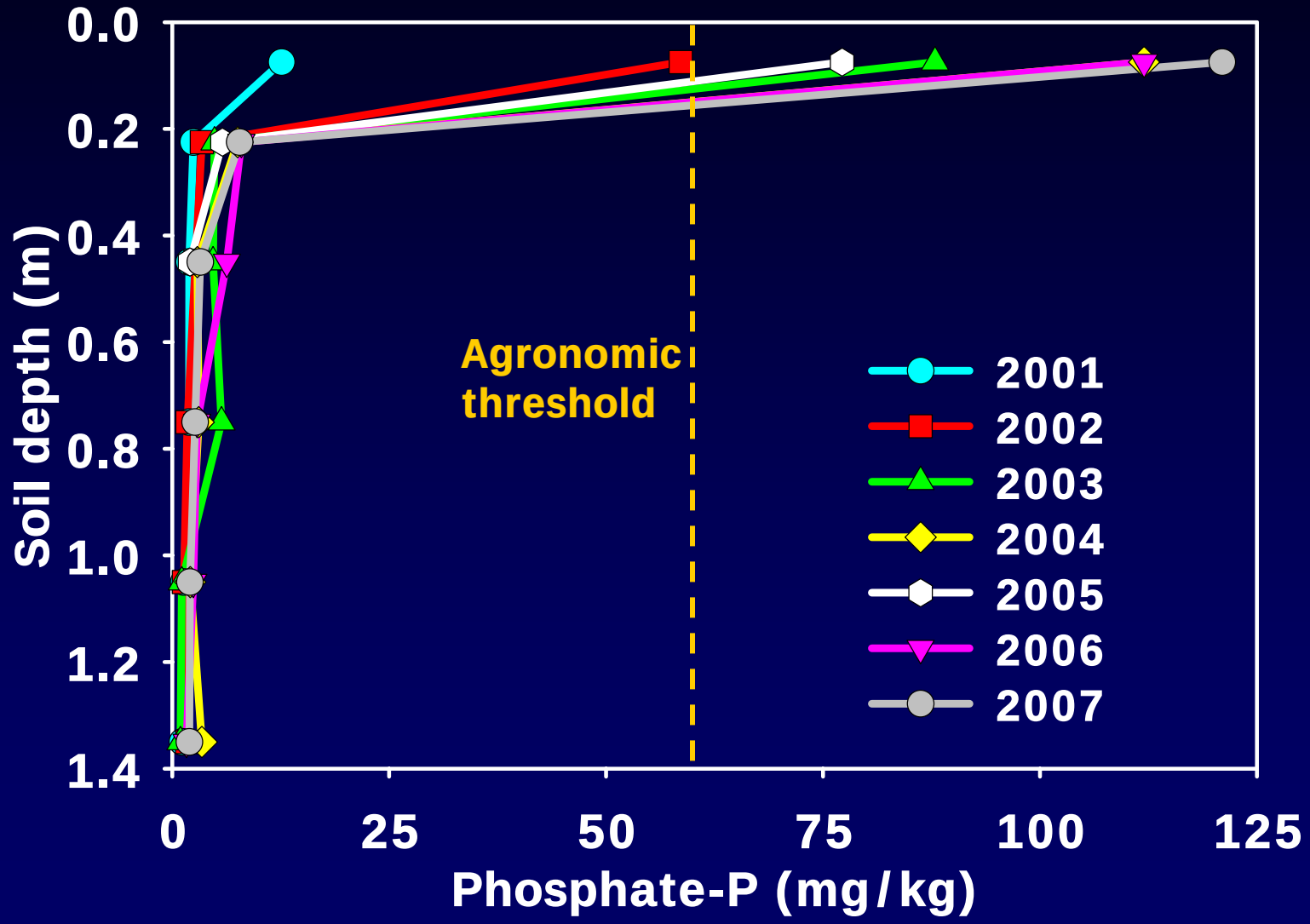
Soil phosphate-P (0-15 cm)

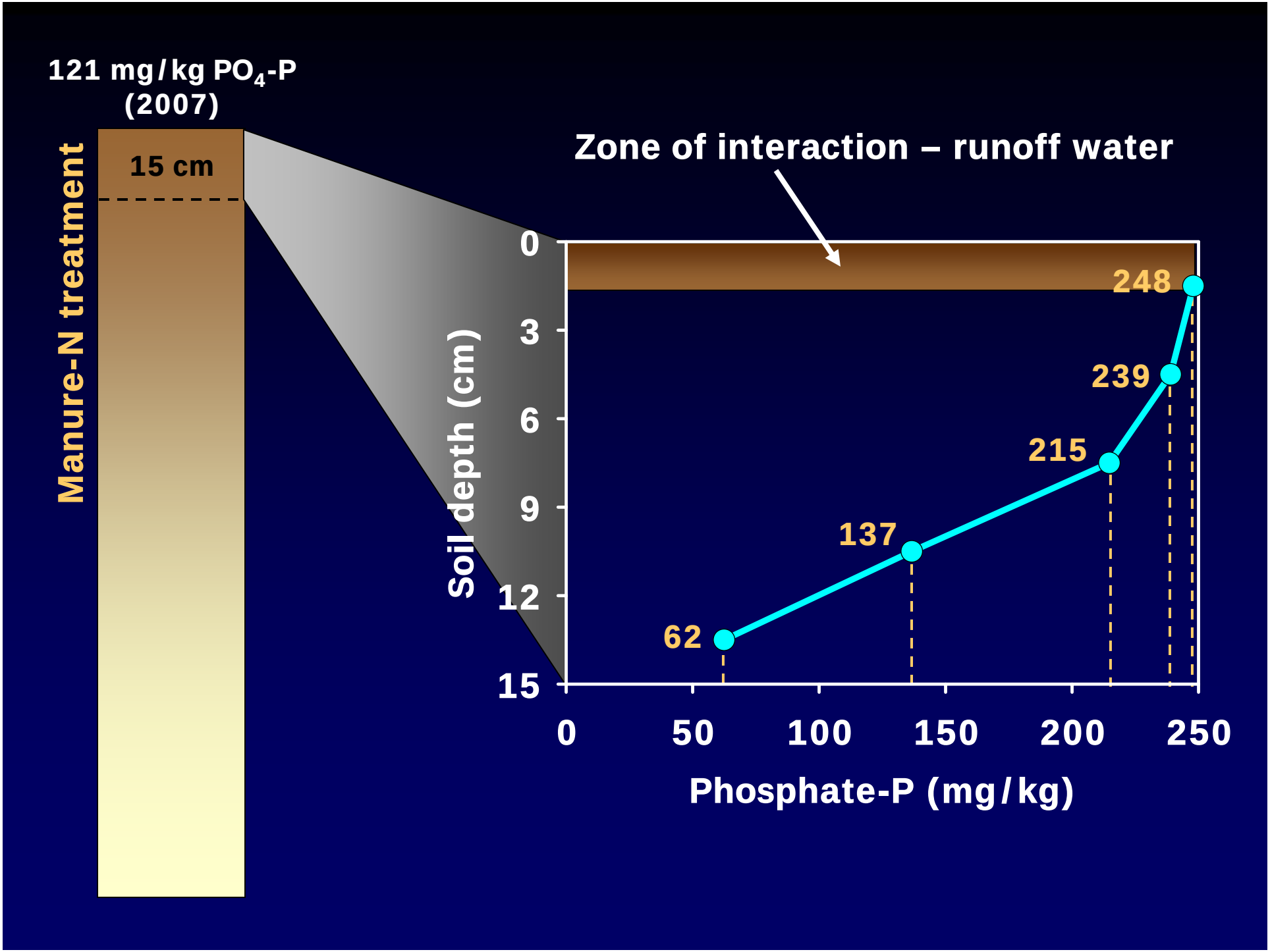
	Cont	FN	FP	FNP	MN	MP	MP3	CN	CP	CP3
	mg / kg									
2001	10	15	11	15	13	9	13	11	11	12
2002	8	8	11	11	59	19	38	36	10	18
2003	6	6	14	9	88	13	52	101	10	14
2004	6	5	17	14	112	16	39	147	12	14
2005	6	6	19	13	77	12	28	125	13	28
2006	5	5	20	10	112	9	20	151	11	16
2007	5	8	20	16	121	13	19	157	13	14

Soil phosphate-P

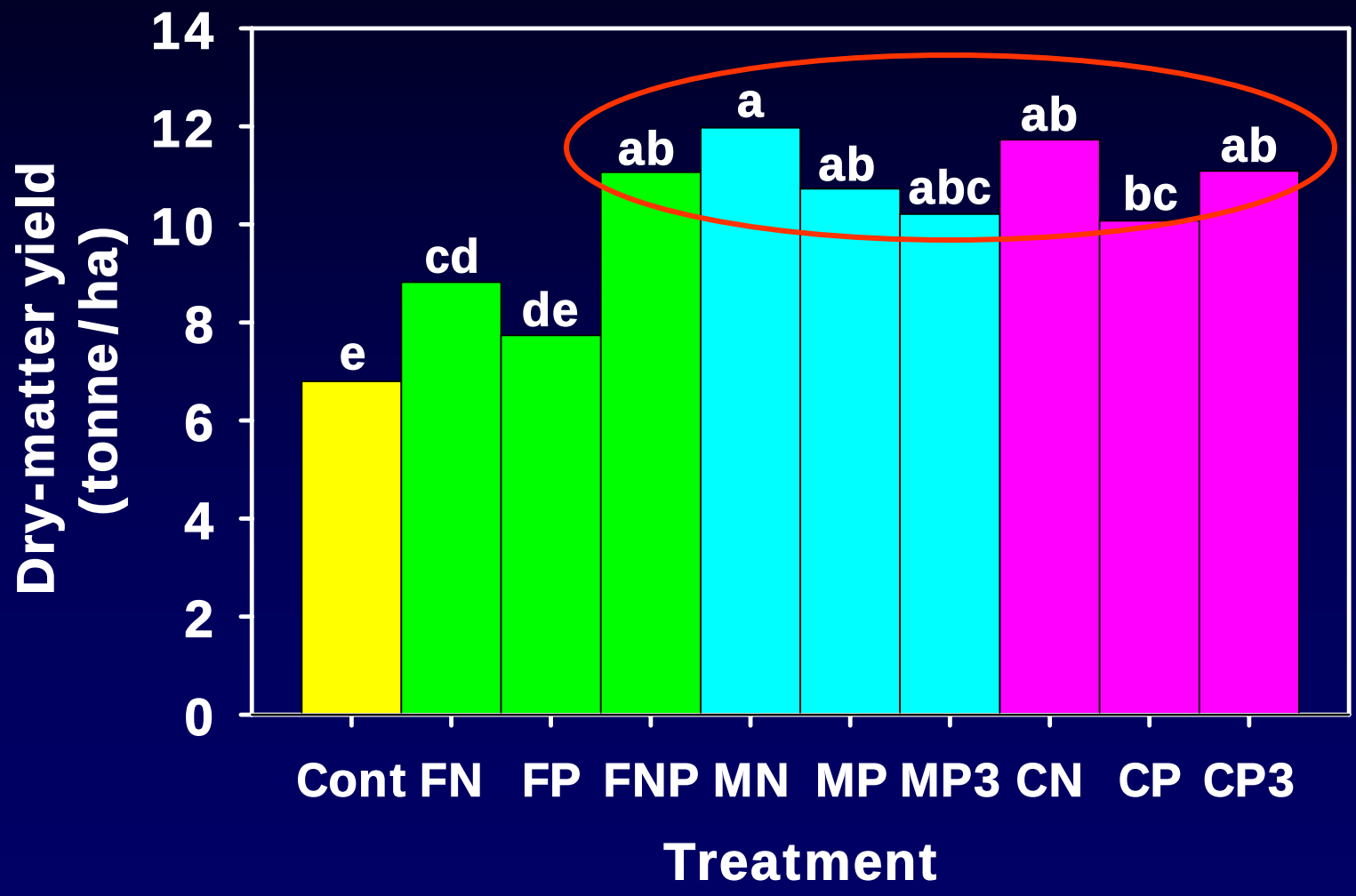


Soil phosphate-P




121 mg/kg PO4-P
(2007)
15 cm
Manure-N treatment
Zone of interaction – runoff water
Soil depth (cm)
0
3
6
9
12
15
62
137
215
239
248
0
50
100
150
200
250
Phosphate-P (mg/kg)

Dry-matter yield – 2007 (barley)



Manure and compost application rates

	2002	2003	2004	2005	2006	2007	Total
	---------- tonne/ha ----------						
Manure N	28	39	11	29	37	51	195
Manure P	10	1	3	4	4	7	29
Manure P3	29	0	0	9	0	0	38
Compost N	48	79	78	60	63	60	388
Compost P	7	8	6	7	5	6	39
Compost P3	22	0	0	25	0	0	47

All rates on a wet-weight basis.

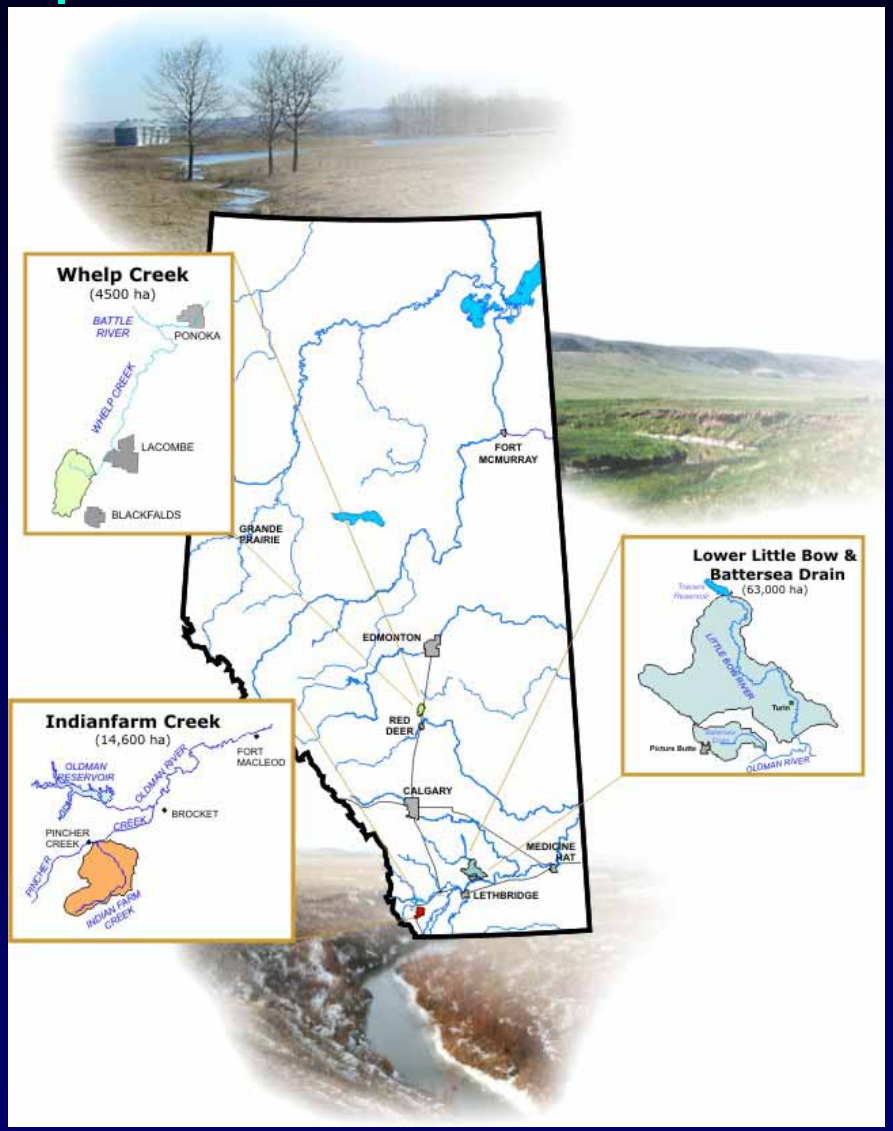
N-based versus P-based rates

Manure N (6 yr)	195 tonne/ha	↓	6.6 x more land
Manure P (6 yr)	29 tonne/ha		
Compost N (6 yr)	388 tonne/ha	↓	9.9 x more land
Compost P (6 yr)	39 tonne/ha		

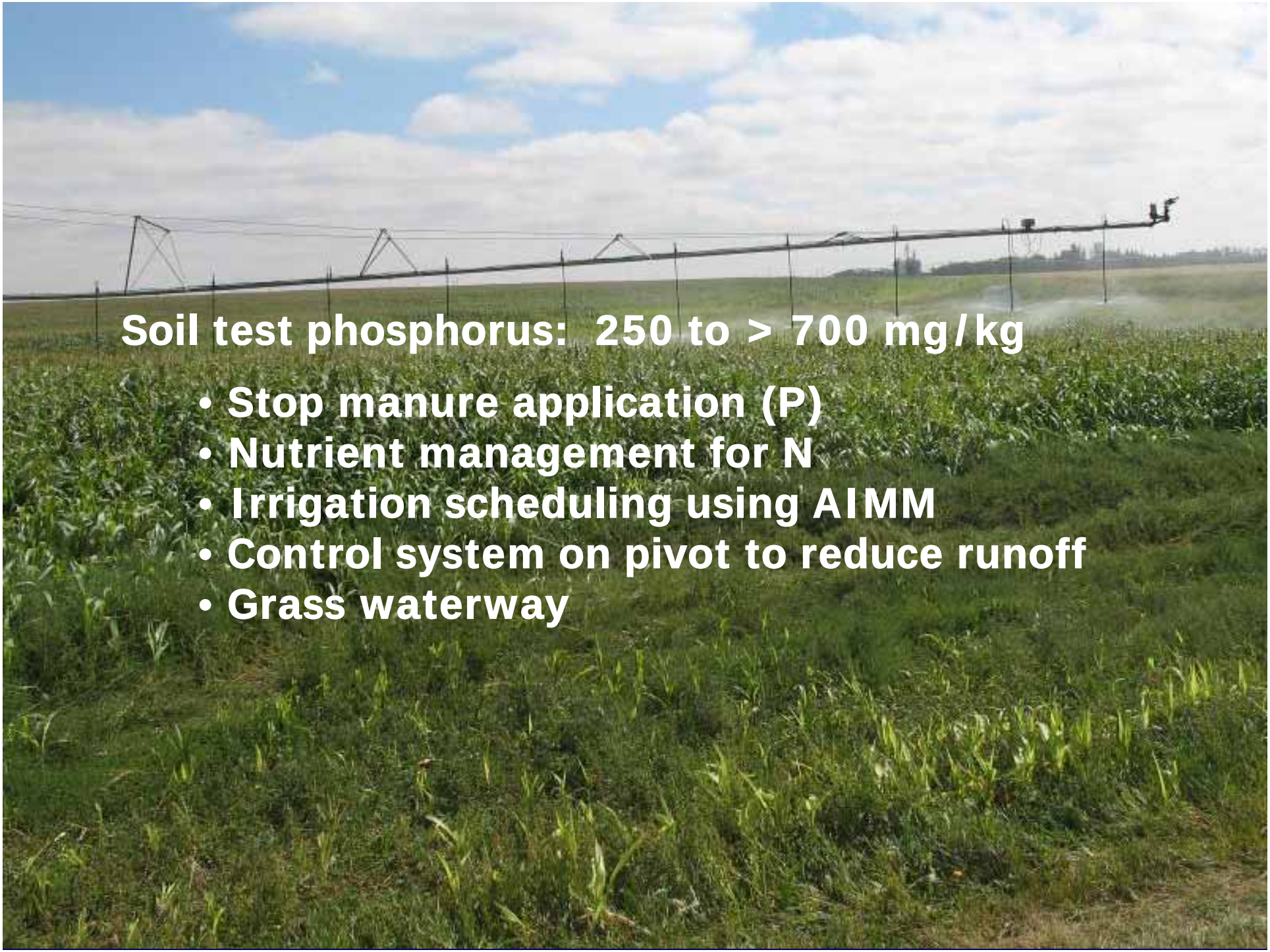
Conclusions

- **There was no net nitrate-N accumulation.**
- **N-based application of manure and compost caused rapid P accumulation.**
- **P-based application of manure and compost resulted in minimal to no P accumulation.**
- **Applying manure and compost based on nutrient management principles achieved optimum yield.**
- **A larger land base is required for the sustainable application of manure nutrients.**

Alberta Nutrient Beneficial Management Practices Evaluation Project (2007-2012)



To evaluate the environmental effectiveness and economic costs of BMP's at the farm scale in agricultural watersheds.


Soil test phosphorus: 250 to > 700 mg/kg
• Stop manure application (P)
• Nutrient management for N
• Irrigation scheduling using AIMM
• Control system on pivot to reduce runoff
• Grass waterway

Thoughts from the past .....

"Through carelessness or ignorance, or both, the most valuable part of the manure is allowed to drain away, finding its way finally to the creek or river, or, to the danger of the health of the household or stock, into the well."

F.T. Shutt 1898
Canadian Dept. of Agriculture

"... it is of highest importance that the manure given by this vast number of animals should be economically handled so that the best possible use be made of the fertilizers it contains."

Wm. Saunders 1896
Canadian Dept. of Agriculture