Following the 4Rs of fertilizer management ensures that your pastures and hay lands will remain perennial winners.

M.D. Timmerman, M.Sc.

Agri-Ecosystems Specialist

Manitoba Agriculture

Manitoba


FERTILIZER CANADA

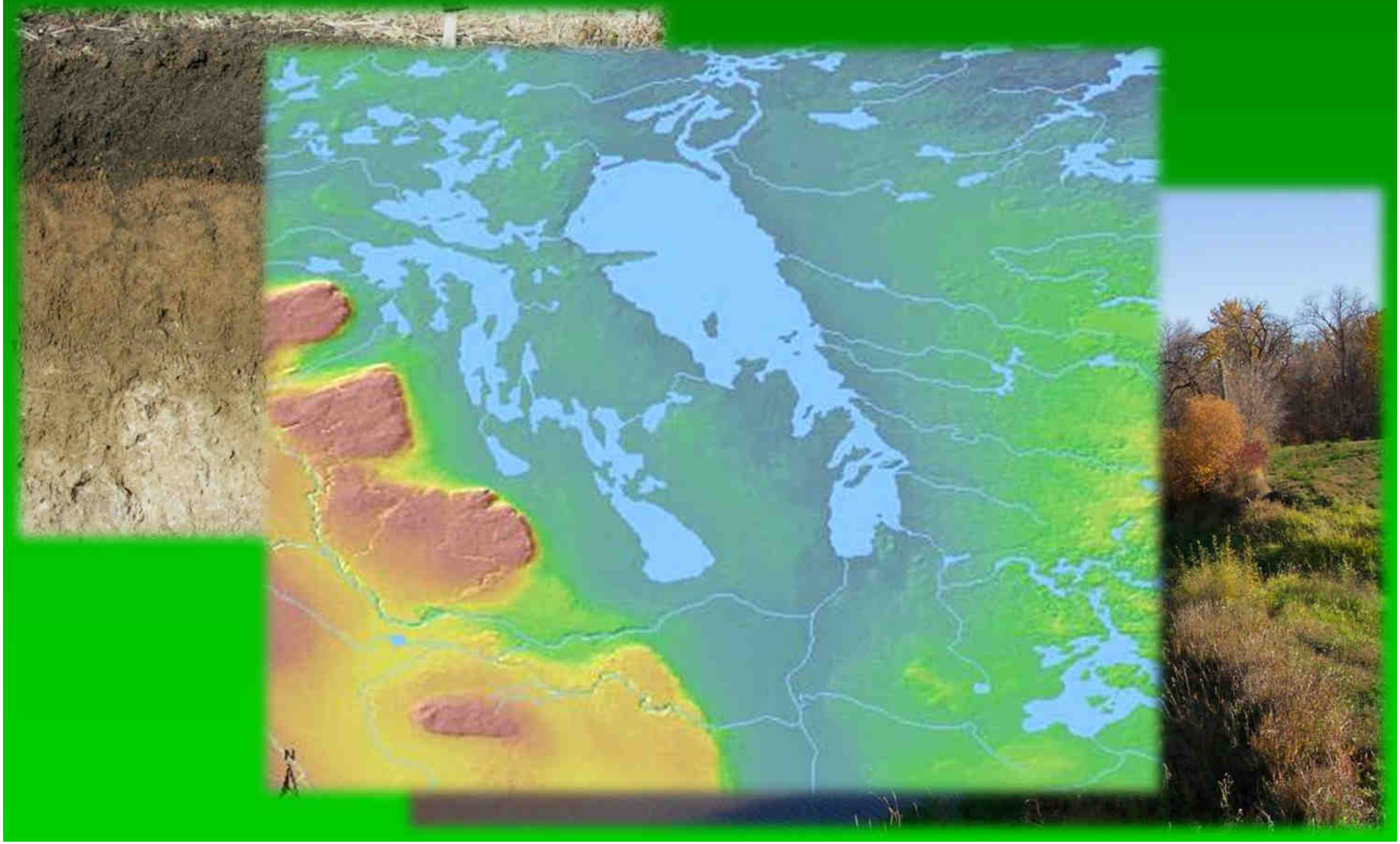

Manitoba


kap
KEYSTONE
AGRICULTURAL
PRODUCERS
of MANITOBA

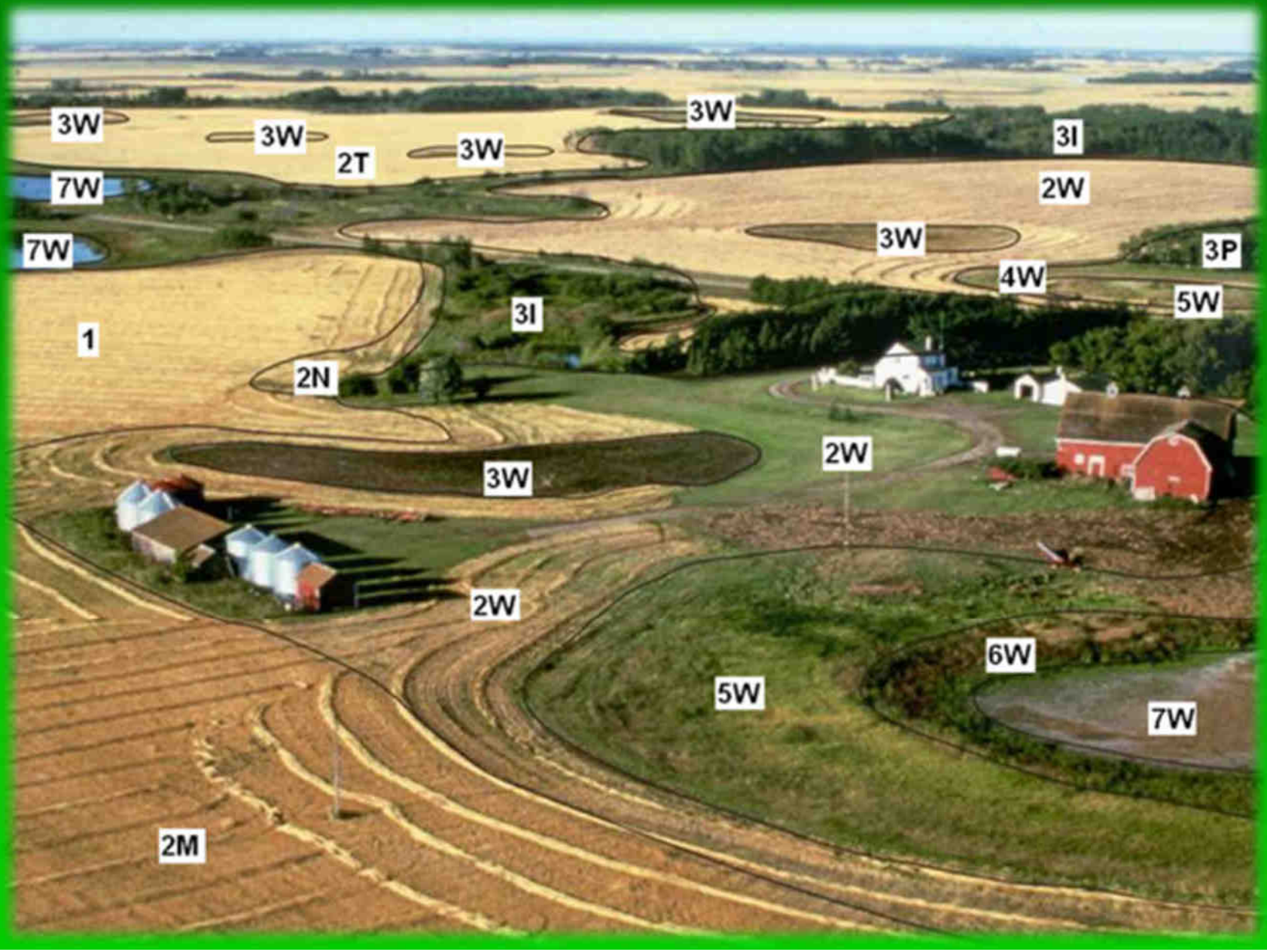
KNOW WHAT YOU HAVE AND USE IT WISELY

If you don't know, find out with data, published or newly collected, and expertise as is available.

Cherishing, and exploiting precious, abundant resources



Soil Information & the 4Rs

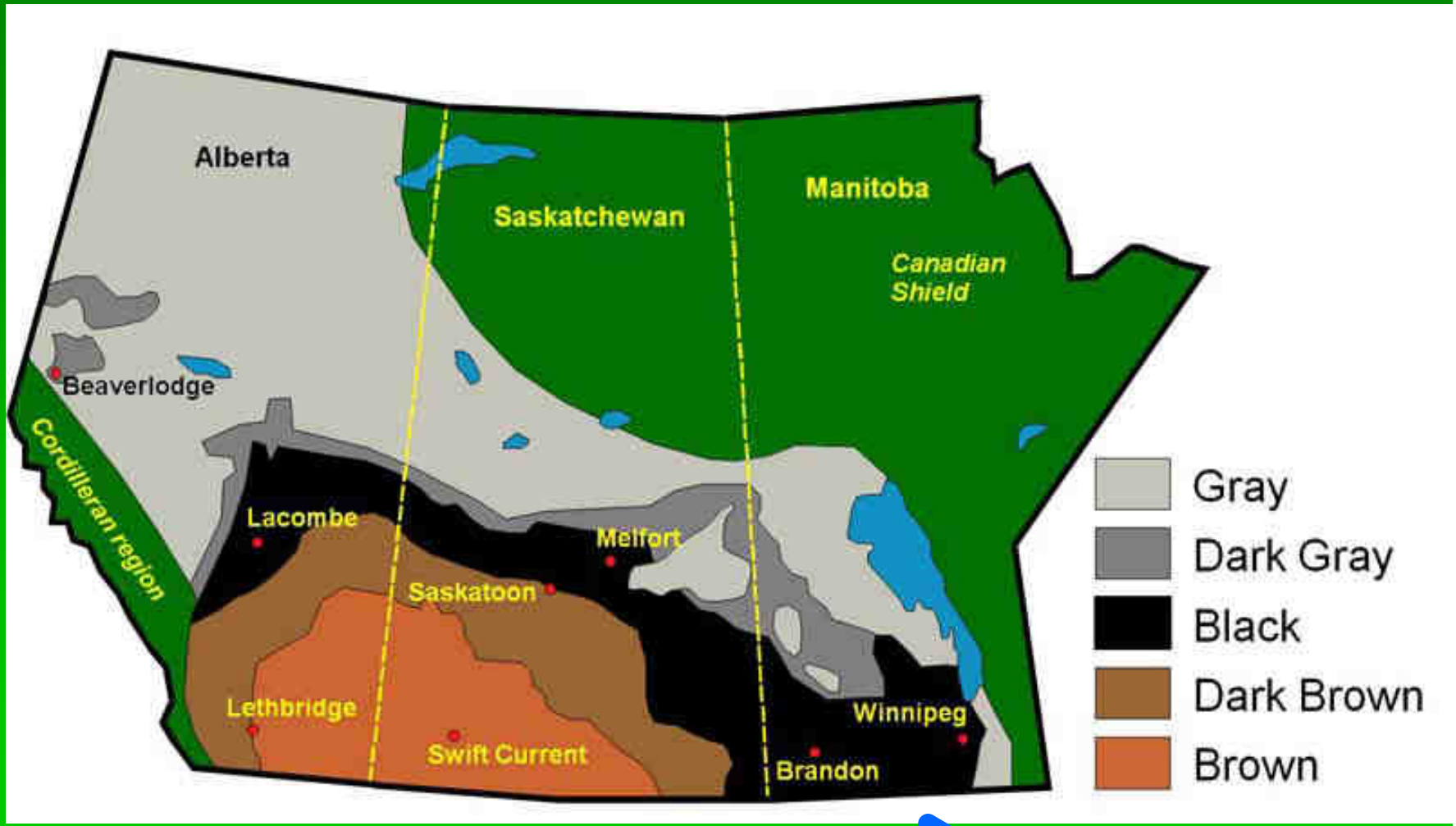


Climate & Weather in the Great Plains Region

And (nearly) every year there occurs “the pause.”

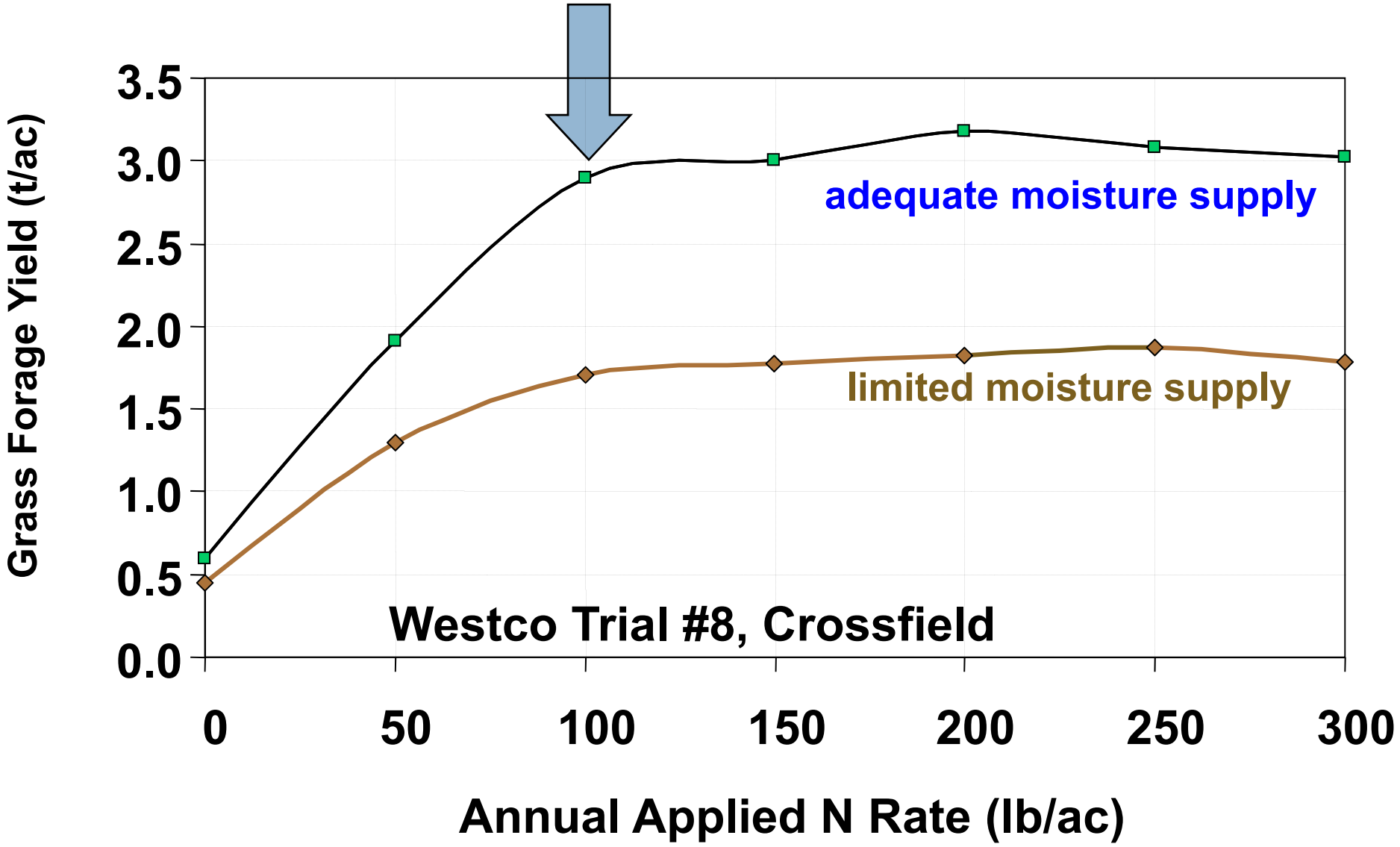
Manitoba – come for the historically, and presently, harsh climate

Soil Zones of *the Canadian Prairies*

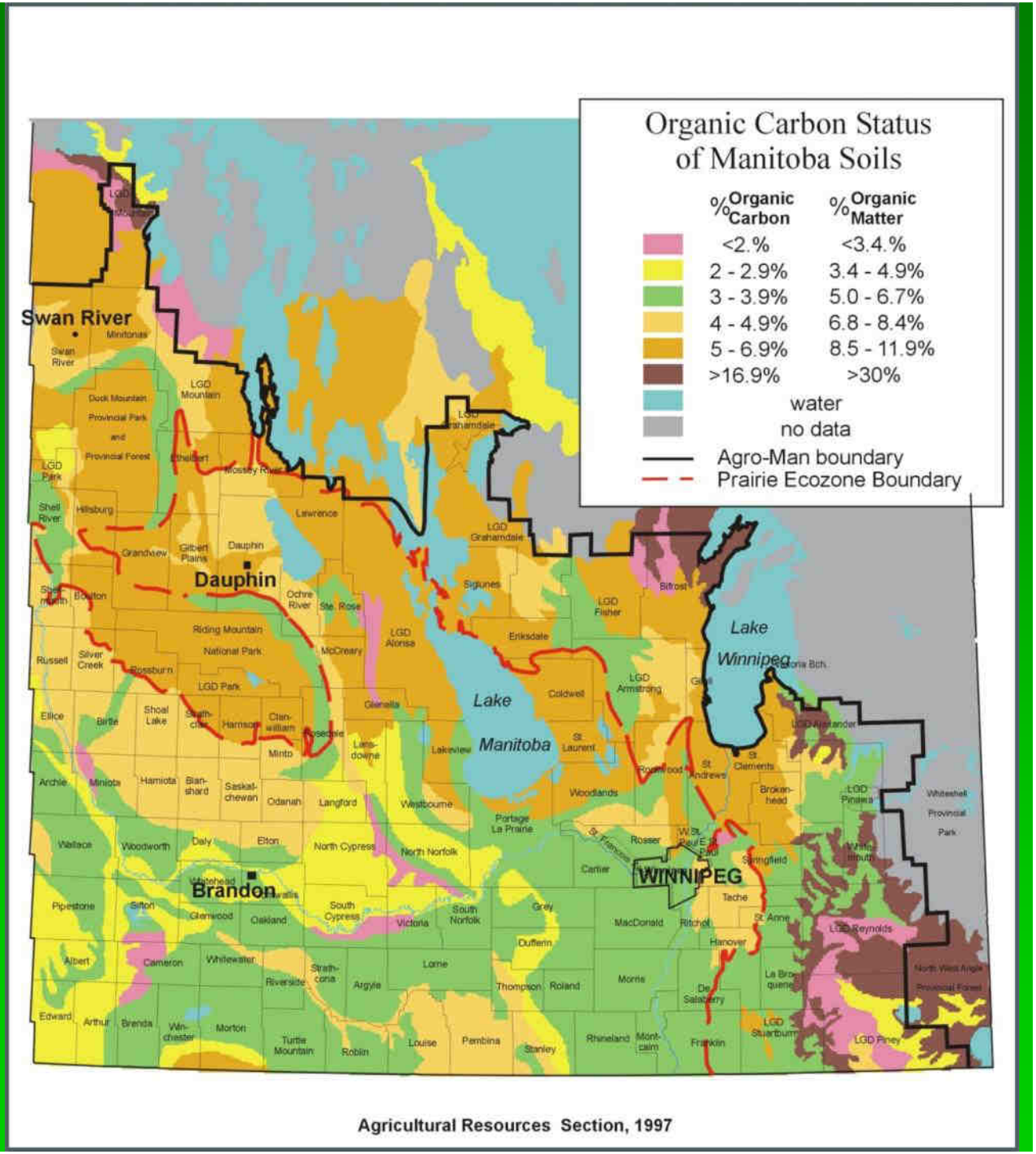


Historically higher precipitation

Water availability to the crop dictates its response to applied N.



Organic C and Organic Matter Levels in Manitoba Soils



ADDRESS 4R LIMITATIONS

Or that magical fertilizer will not perform any magic!


Is your soil
healthy?

Eroded landscapes are colour coded

Replenish with manure or soil from lower slopes

Indicator weeds – acidic soil

- Devils paintbrush (orange hawkweed)

Indicator weeds – compaction

Indicator weeds – salinity

Odour – does this soil stink?

- Excess water – anaerobic microbes, H_2S emitted
- Good, earthy smell = actinomycetes

Drainage

- Improving drainage can be the essential precursor to successful 4R managment
- Improving drainage can also influence the pathways of nutrient movement.

Surface drainage (obvious)

Surface drainage (subtle)


TILE
DRAINAGE
Expensive investments to
address a 4R limitation

To achieve perennial winners, apply

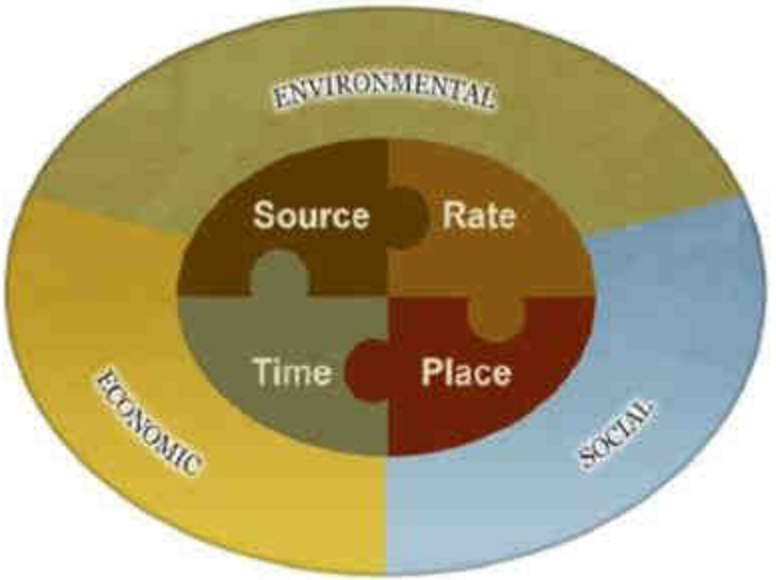
the **Right** *source*

at the

Right *rate*,

Right *time*,

Right *place*.



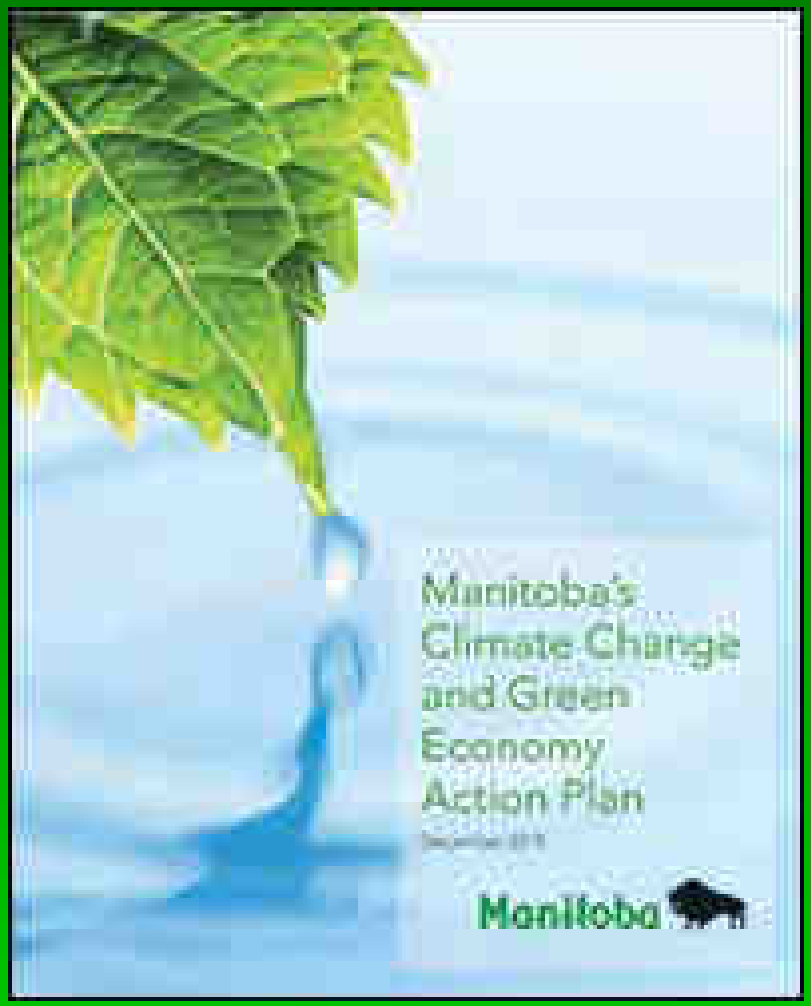
4 nutrient stewardship

IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

RIGHT ***SOURCE***

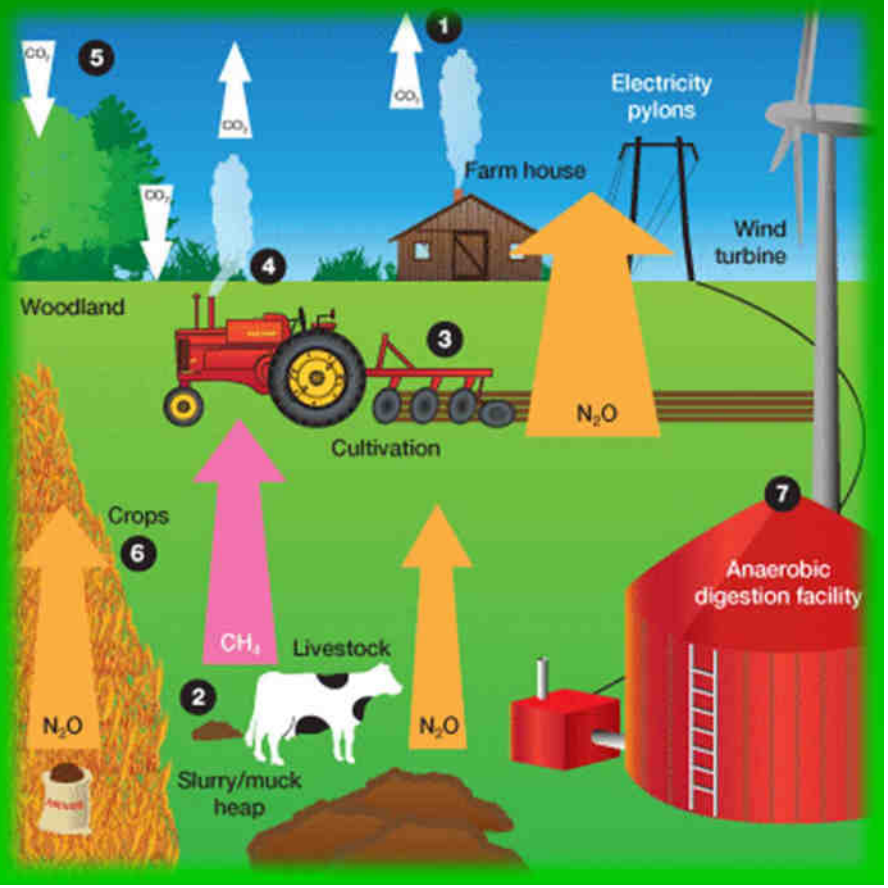
If it's available...and econonomical...

If it's available...and econonomical...

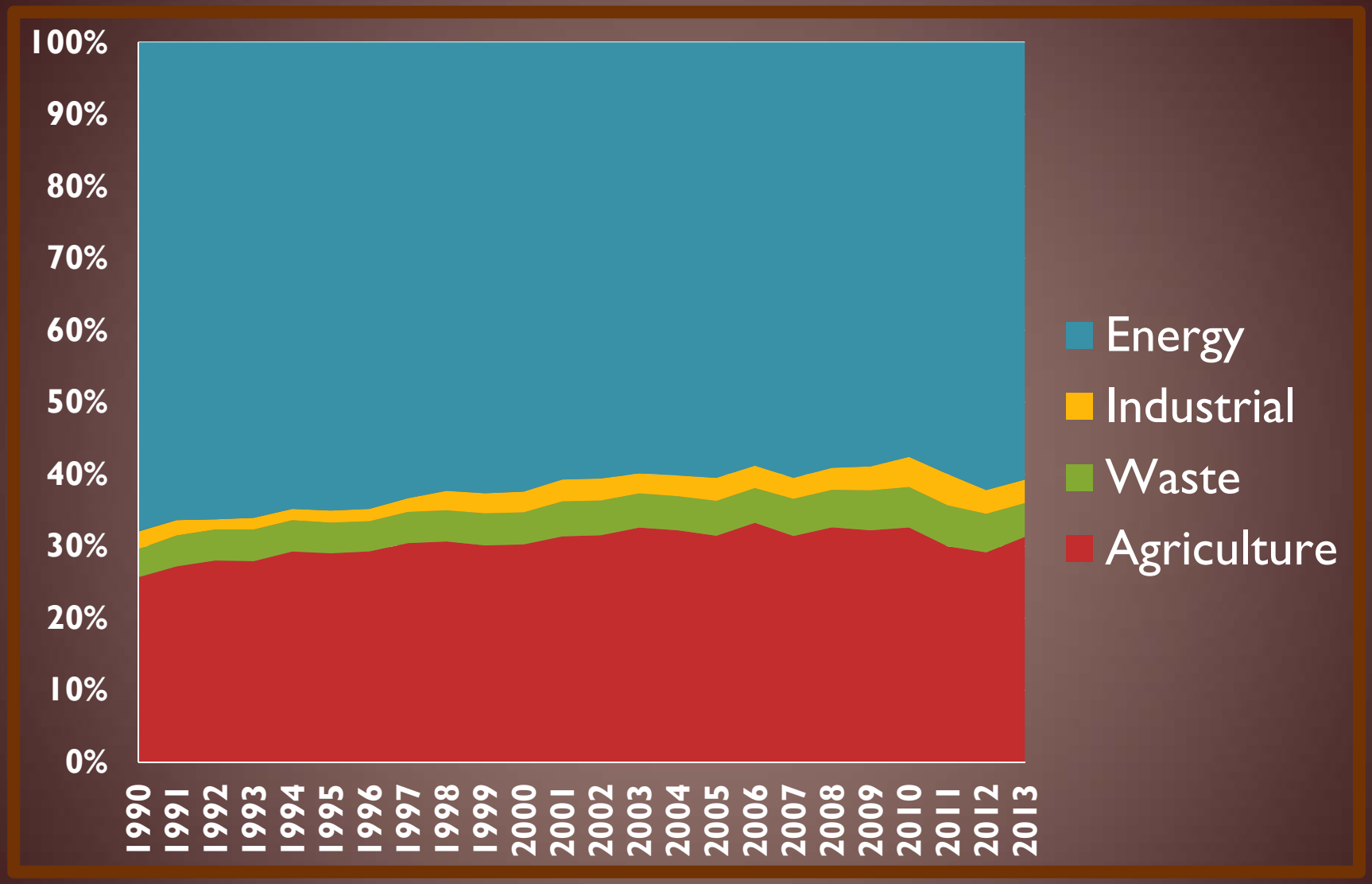


Agriculture and Climate Change

Agricultural GHG Emissions

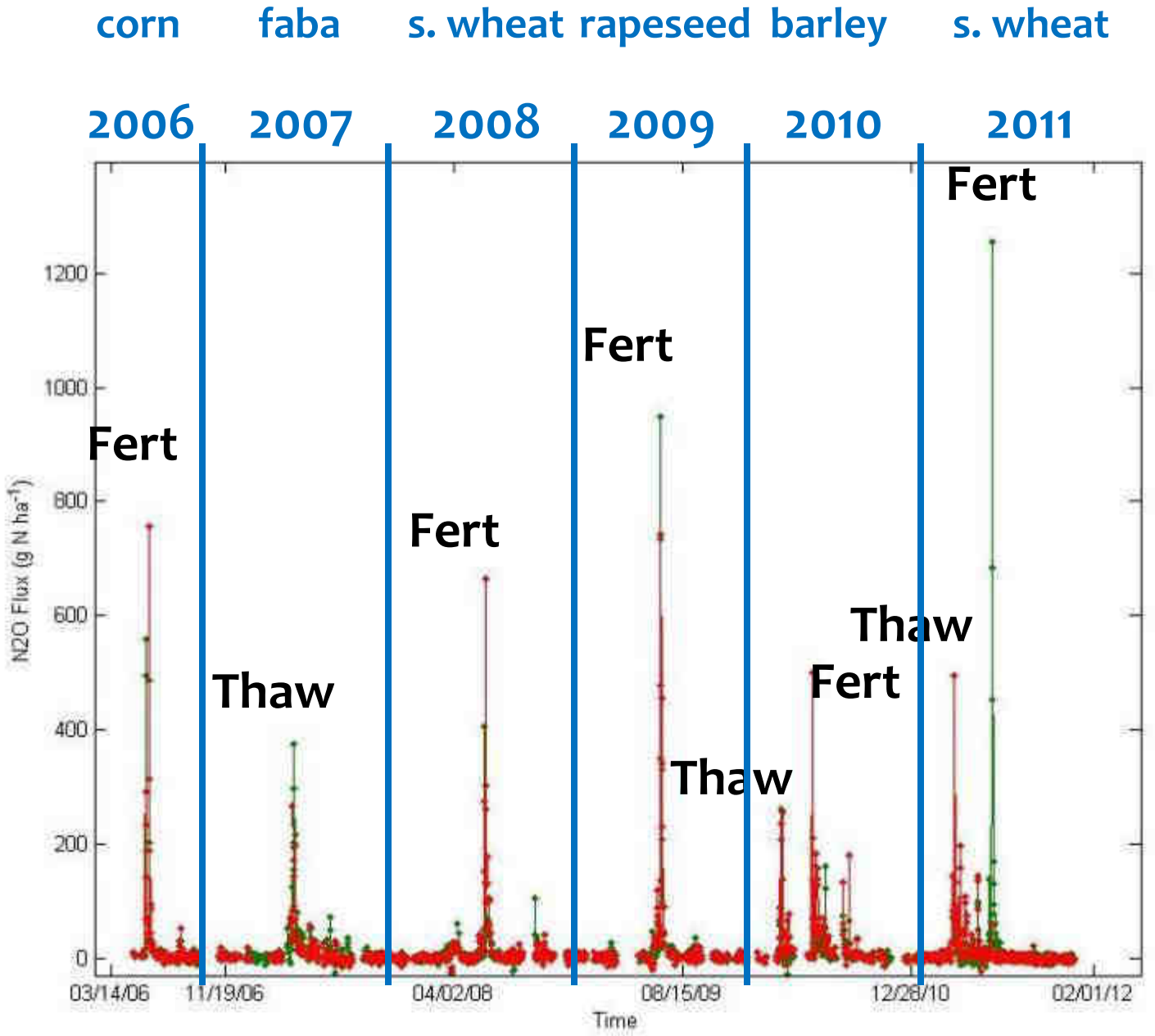


Is this a problem or an opportunity?



Relative contributions of Manitoba GHG source categories from 1990 to 2013.

Adding N Fertilizer Causes N_2O Emission

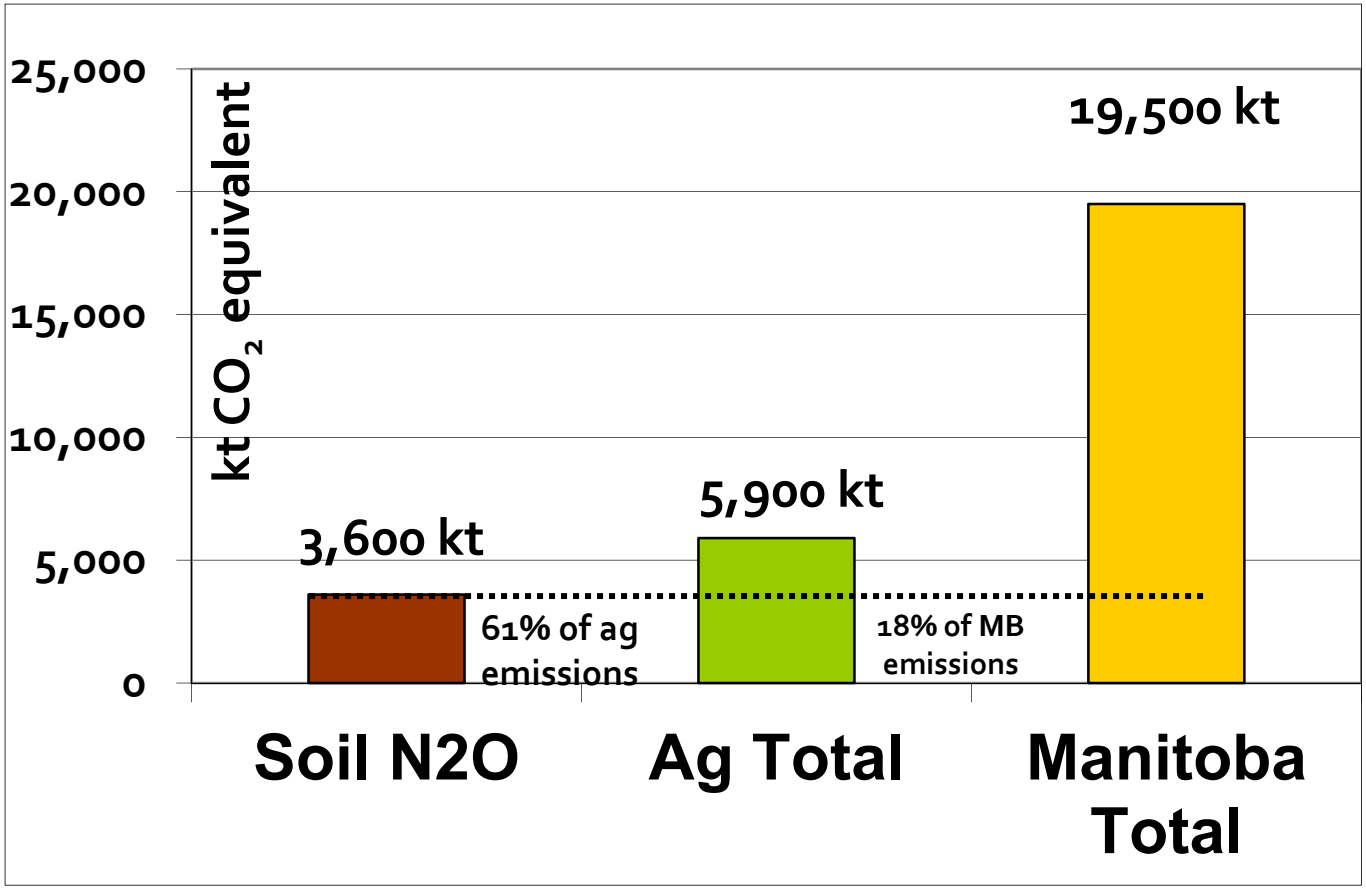


Glenn et al. 2012 Ag For Met 166-167:41-49

Stewart 2011 MSc

Hanis PhD in progress

How much does N_2O from agricultural soils contribute to GHG emissions?



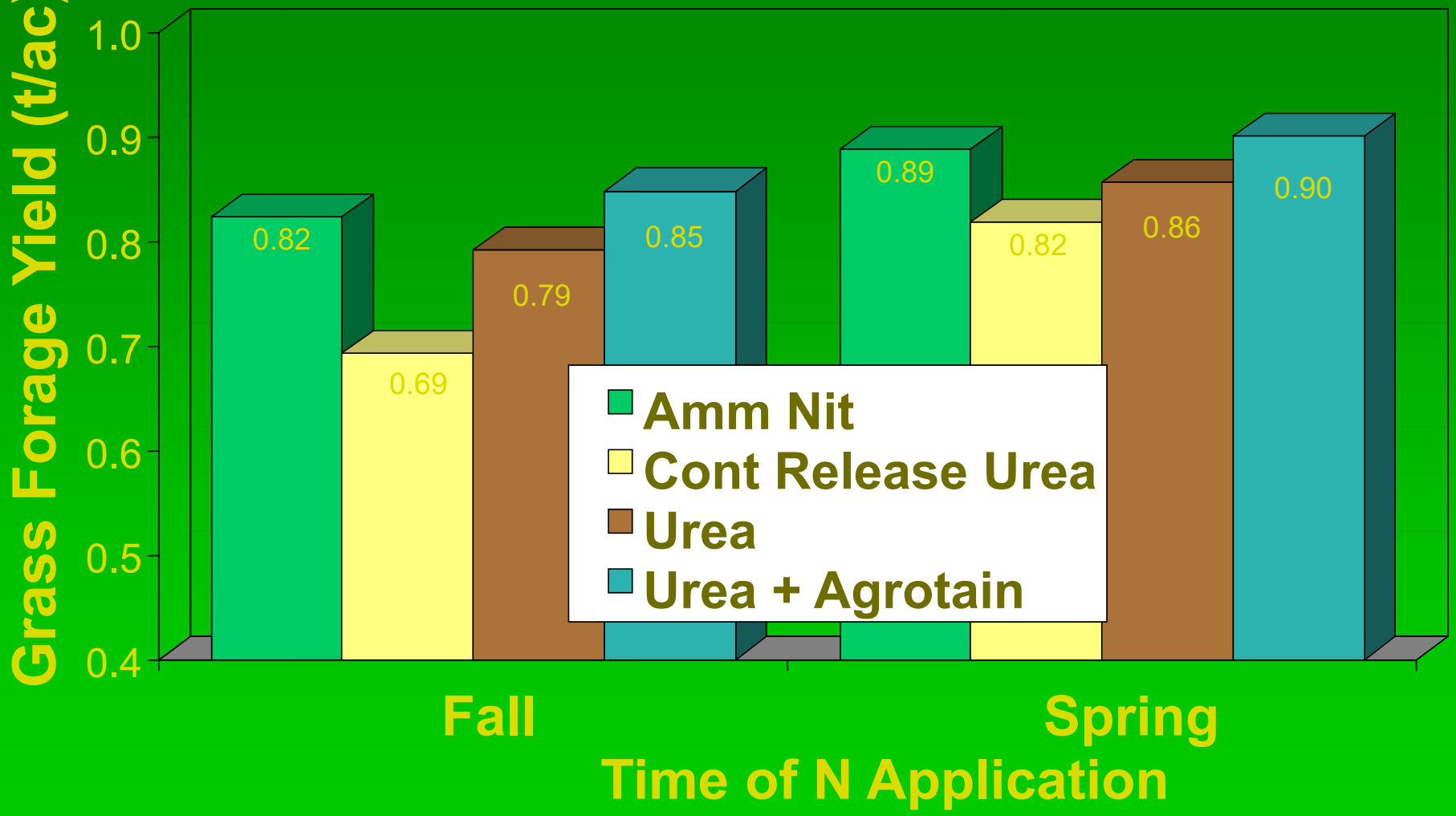
Source: Environment Canada. National Inventory Report 1990-2011.

Synthetic Fertilizer Formulation

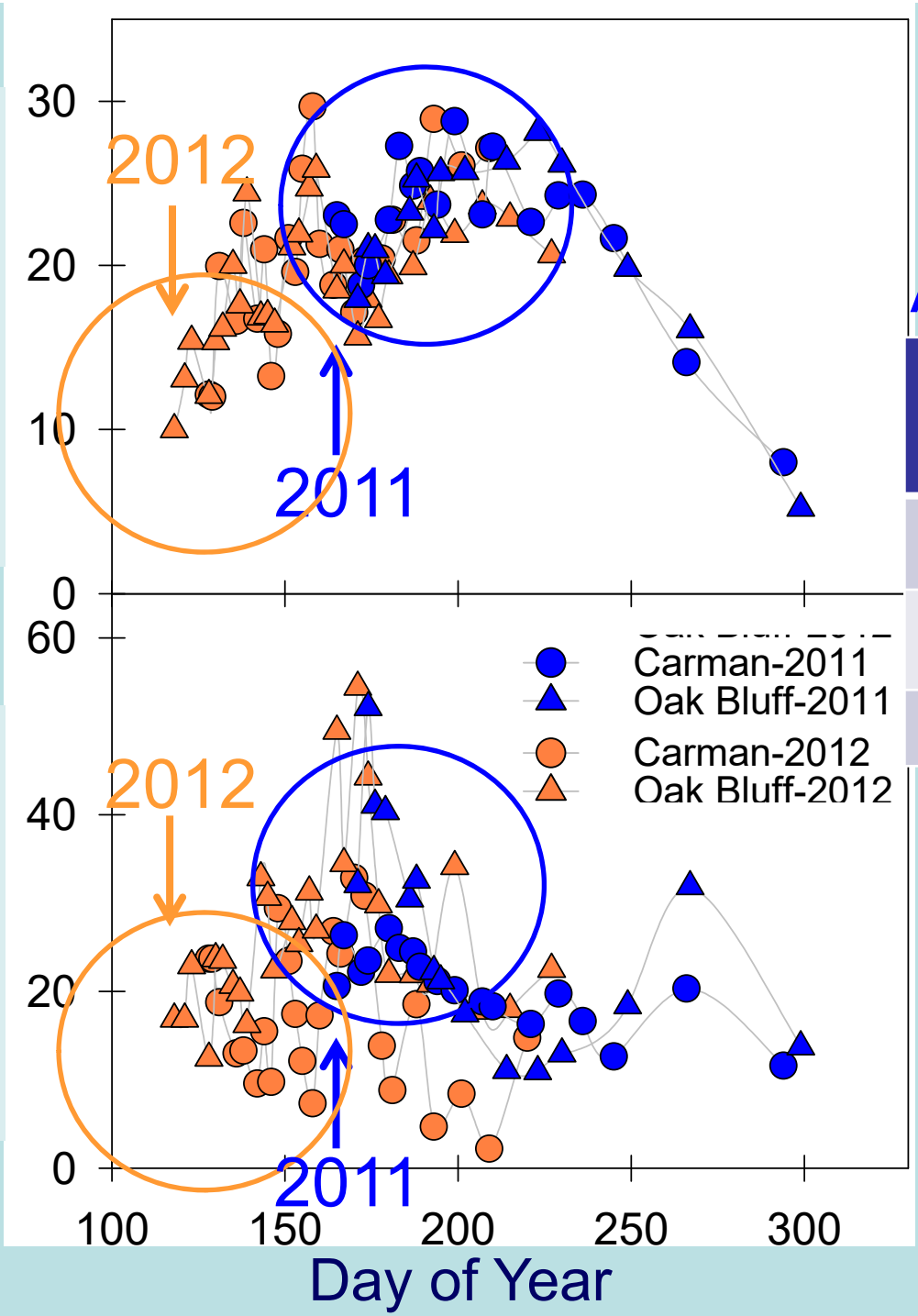
- ***Granular urea*** – most prevalent N source
- ***Enhanced Efficiency Fertilizer (EEF)***
  - ***Stabilized N*** – incorporate inhibitors to slow transformation of urea and/or NH_4^+ (**SUPERU™**)
  - ***Controlled release N*** – release based on soil temperature and moisture (Environmental Smart N, aka **ESN**)

polymer-coated

Performance of Various N Products



Σουρχε: Ωεστχο



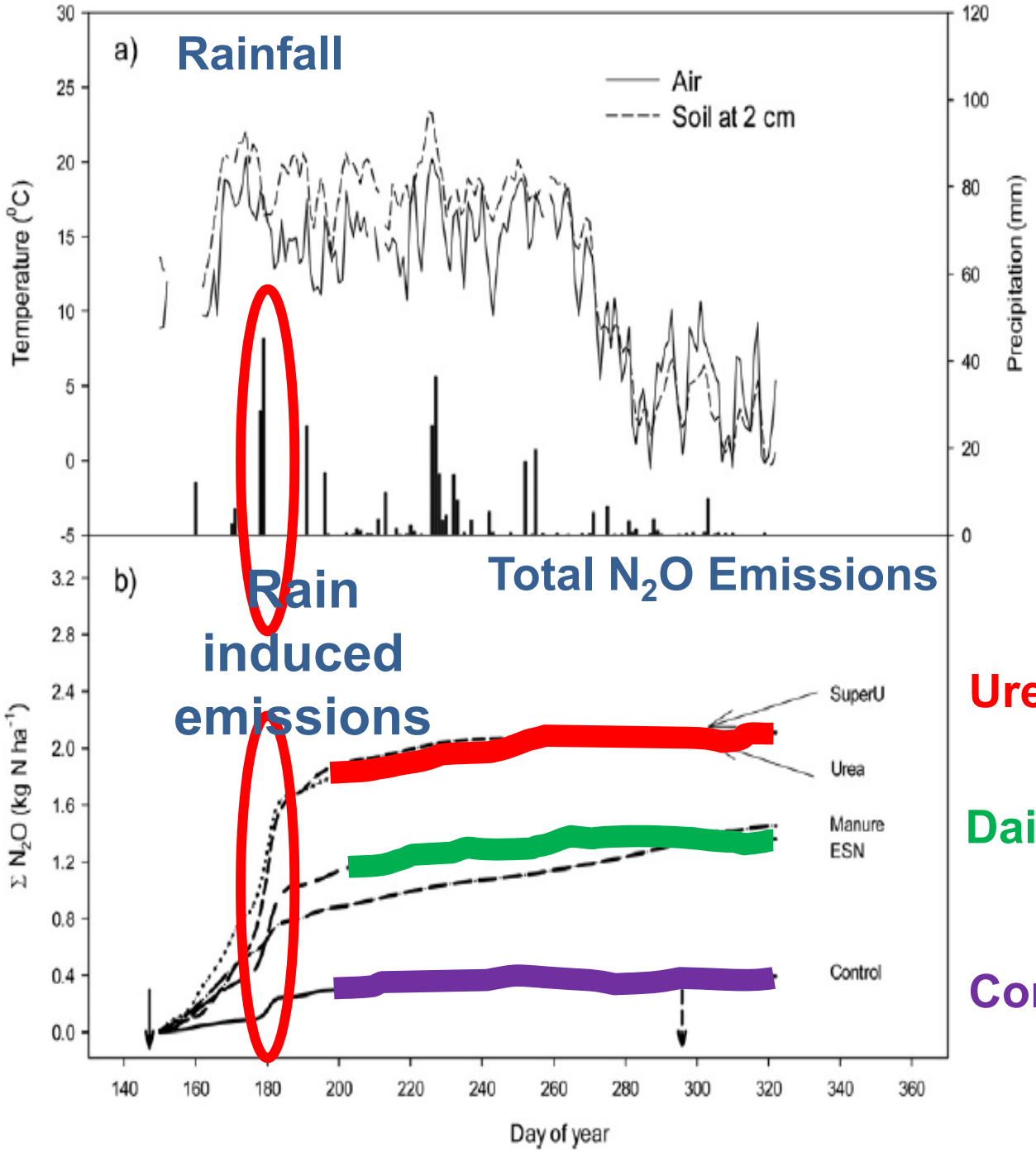
At fertilizer addition:

	Temp (°C)		VMC (%)	
	Car	Oak	Car	Oak
2011	~20	~20	~25	~40
2012	~12	~12	~20	~20

High moisture and temp.

⇩

More N_2O production



Broadcast with incorporation

N_2O Emission losses in 2009 at Glenlea

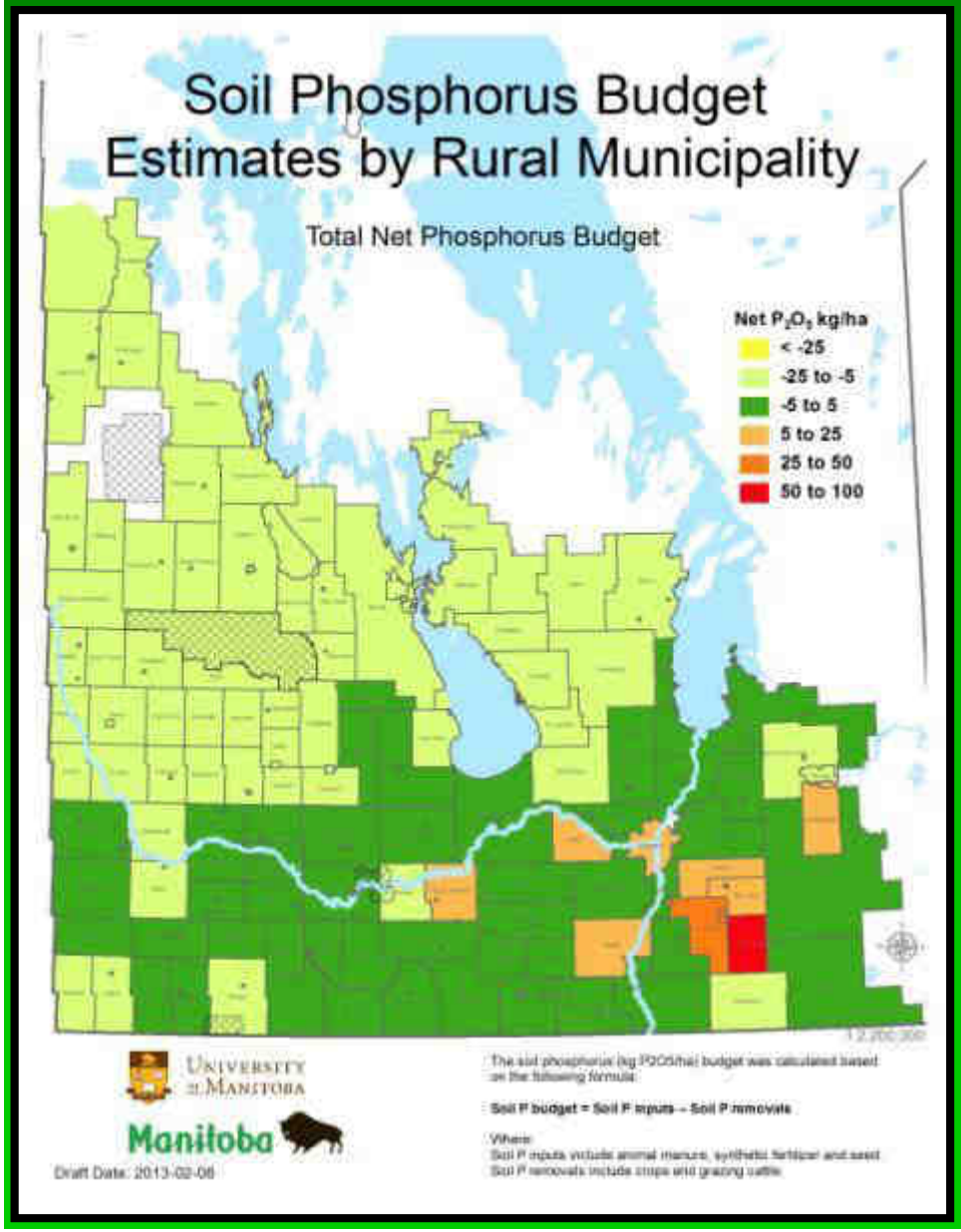
Urea and SuperU

Dairy Manure and ESN

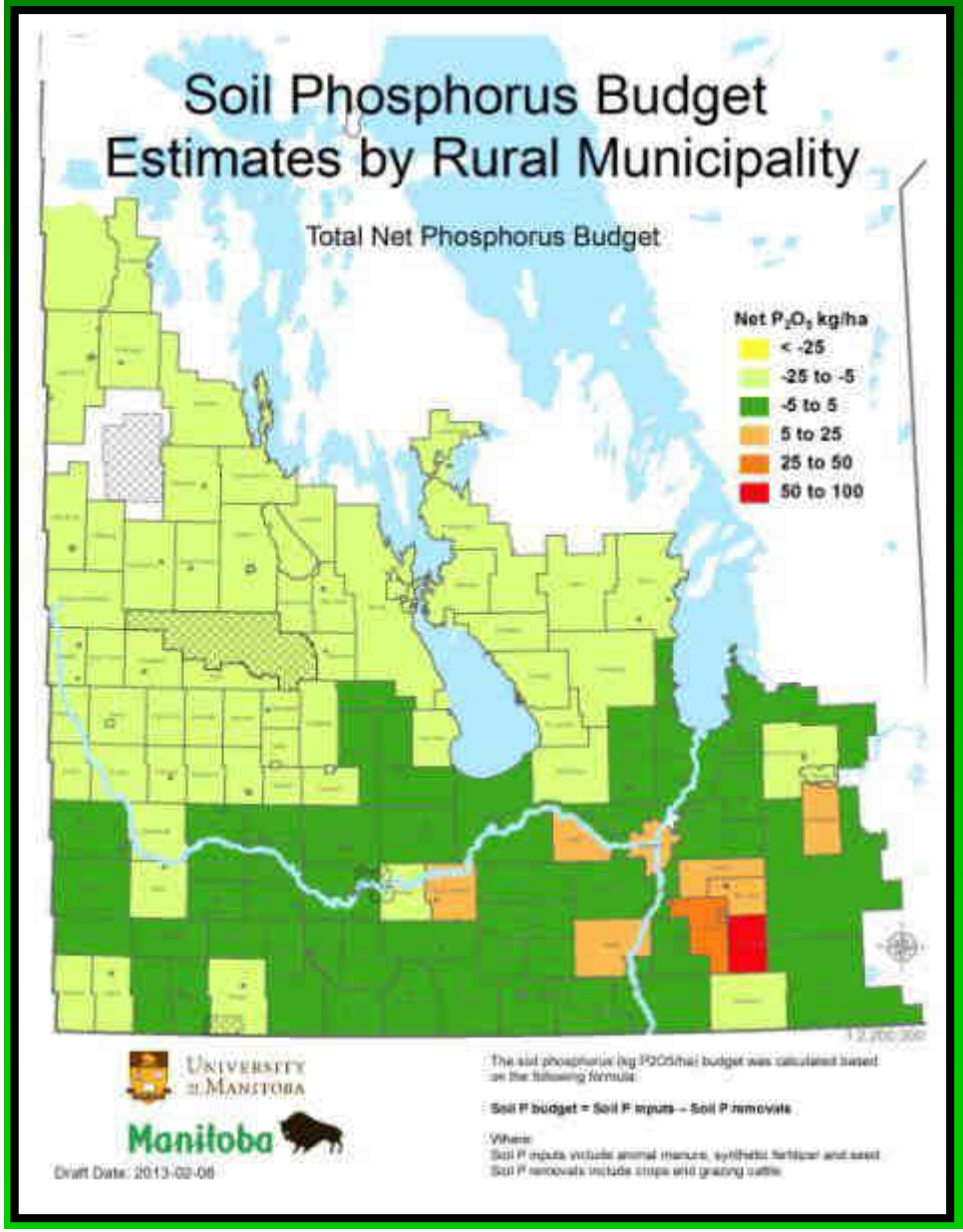
Control – No N

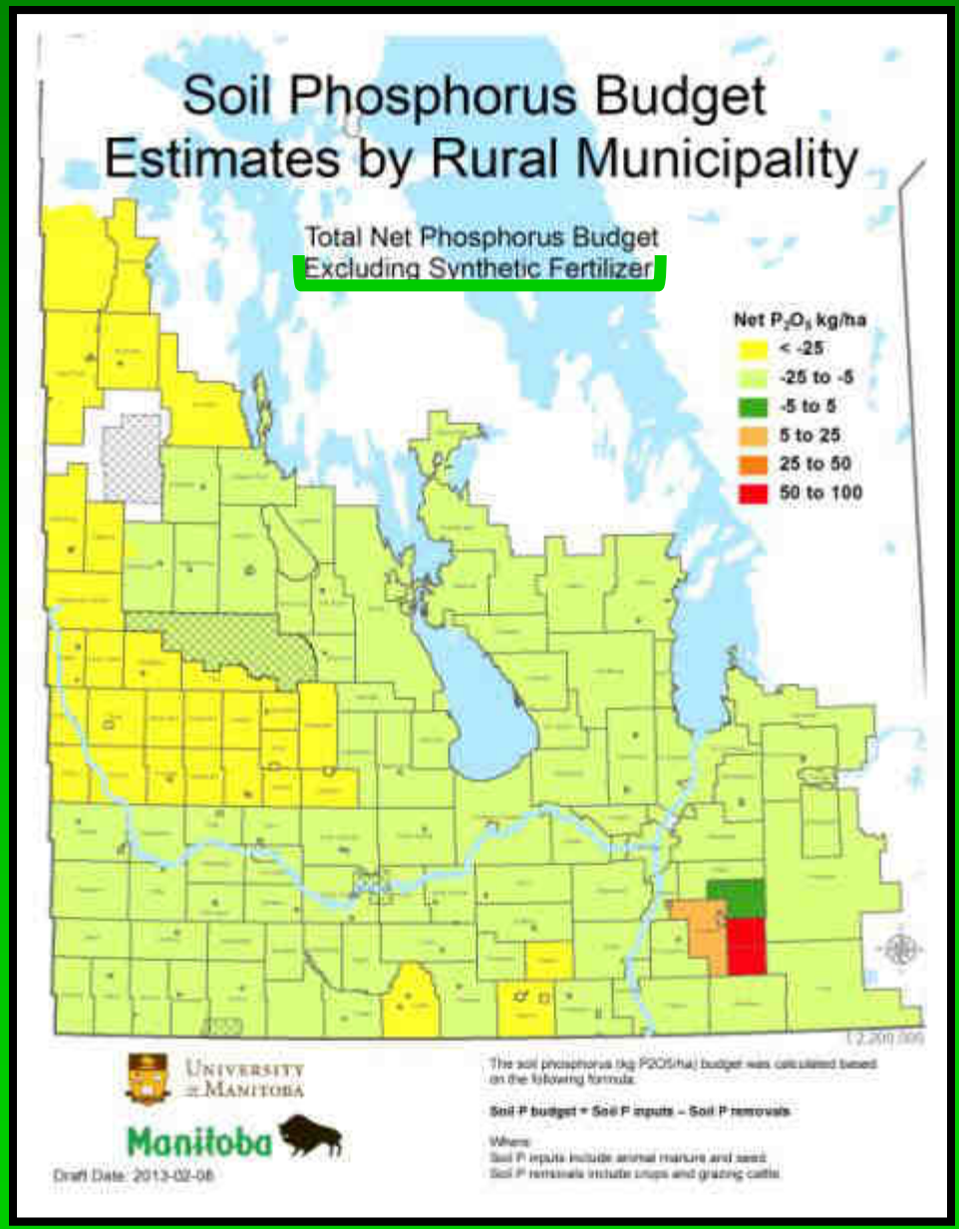
Is there too much P in Manitoba's soils?

Too much phosphorus in Manitoba? – only in a few places.



Too much phosphorus in Manitoba? – only in a few places.





Trouble starts at very low concentrations of P:

<u>20-50 ppb</u>.

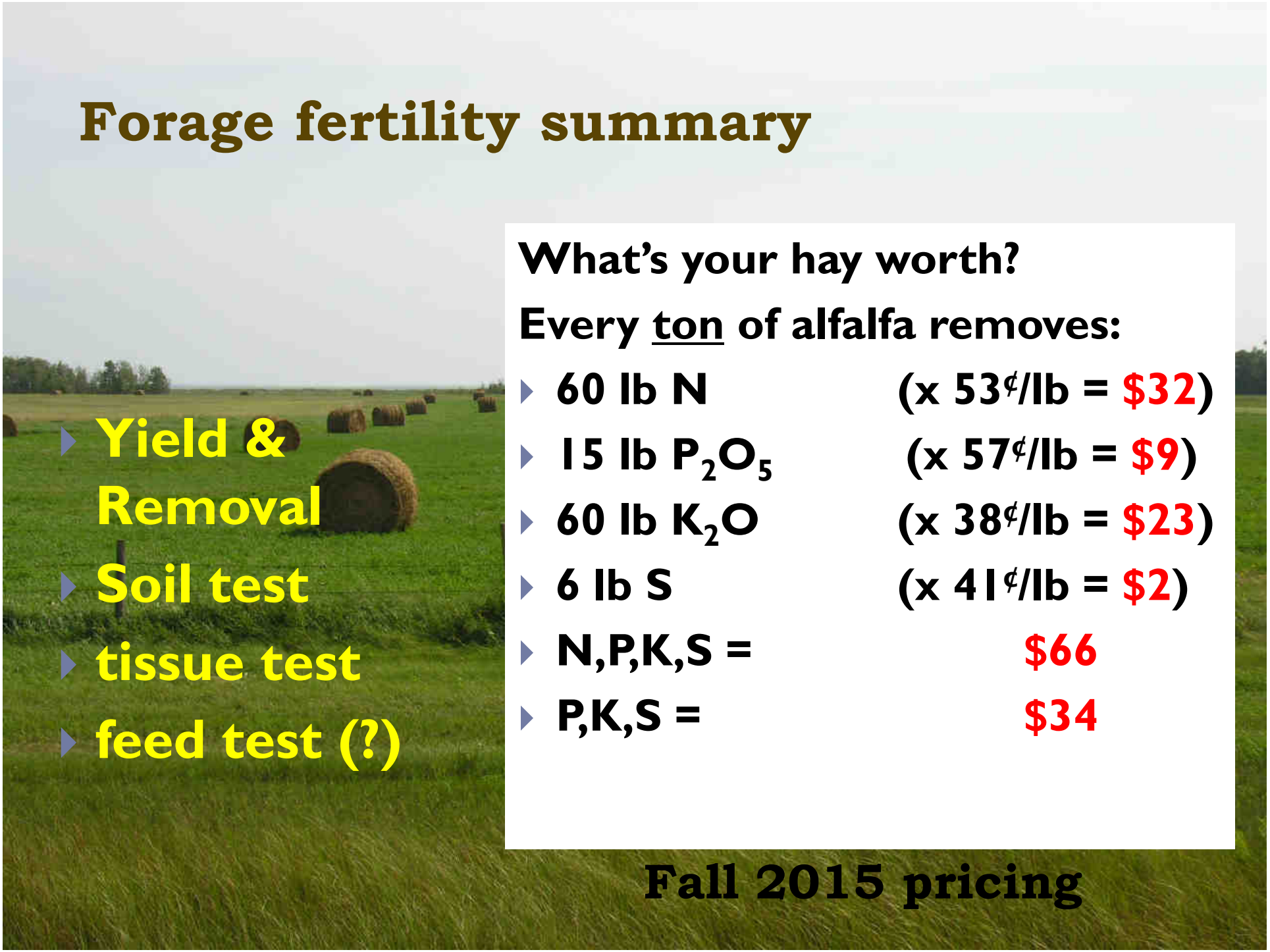
Farmers typically manage soil P in the range of 5-20 **<u>ppm</u>**.

RIGHT *RATE*

What nutrient is missing?

a. Nitrogen
b. Phosphorus
c. Potassium
d. Sulphur

Forage fertility summary



- Yield & Removal
- Soil test
- tissue test
- feed test (?)

What's your hay worth?

Every <u>ton</u> of alfalfa removes:

- 60 lb N (x 53¢/lb = $32)
- 15 lb P_2O_5 (x 57¢/lb = $9)
- 60 lb K_2O (x 38¢/lb = $23)
- 6 lb S (x 41¢/lb = $2)
- N,P,K,S = $66
- P,K,S = $34

Fall 2015 pricing

How do you know crop is malnourished?

Suspicion

1. Low yielding
2. Winter kill
3. Weedy
4. Low quality feed
5. Fertility patterns

Confirmation

1. Does the math add up?
2. Visual symptoms
3. Feed analysis
4. Soil test
5. Test strips

Date Sampled: Date Received: 11/09/2020 Date Reported:

Nutrient In The Soil		Interpretation			
		VLOW	Low	Med	High
Nitrate	0-6" 4 lb/ac 6-24" 12 lb/ac 0-24" 16 lb/ac	***			
Phosphorus	Olsen 3 ppm	******			
Potassium	91 ppm	**********			
Chloride					
Sulfur	0-6" 10 lb/ac 6-24" 72 lb/ac	**********	**********	**********	**********
Boron					
Zinc	0.87 ppm	**********	**********	******	
Iron					
Manganese					
Copper	0.6 ppm	**********	**********		
Magnesium					
Calcium					
Sodium					
Org Matter	5.2 %	**********	**********	**********	**********
Carbonate(ECC)					
Sol. Salts	0-6" 0.27 mmho/cm 6-24" 0.32 mmho/cm	******	**********		

1st Crop Choice		
Grass/Pasture		
YIELD GOAL		
1 Tons		
SUGGESTED GUIDELINES		
Broadcast		
LB/ACRE		APPLICATION
N	36	
P_2O_5	13	Broadcast
K_2O	12	Broadcast
Cl		
S	10	Broadcast
B		
Zn	0	
Fe		
Mn		
Cu	0	
Mg		
Lime		

2nd Crop Choice		
YIELD GOAL		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

3rd Crop Choice		
YIELD GOAL		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

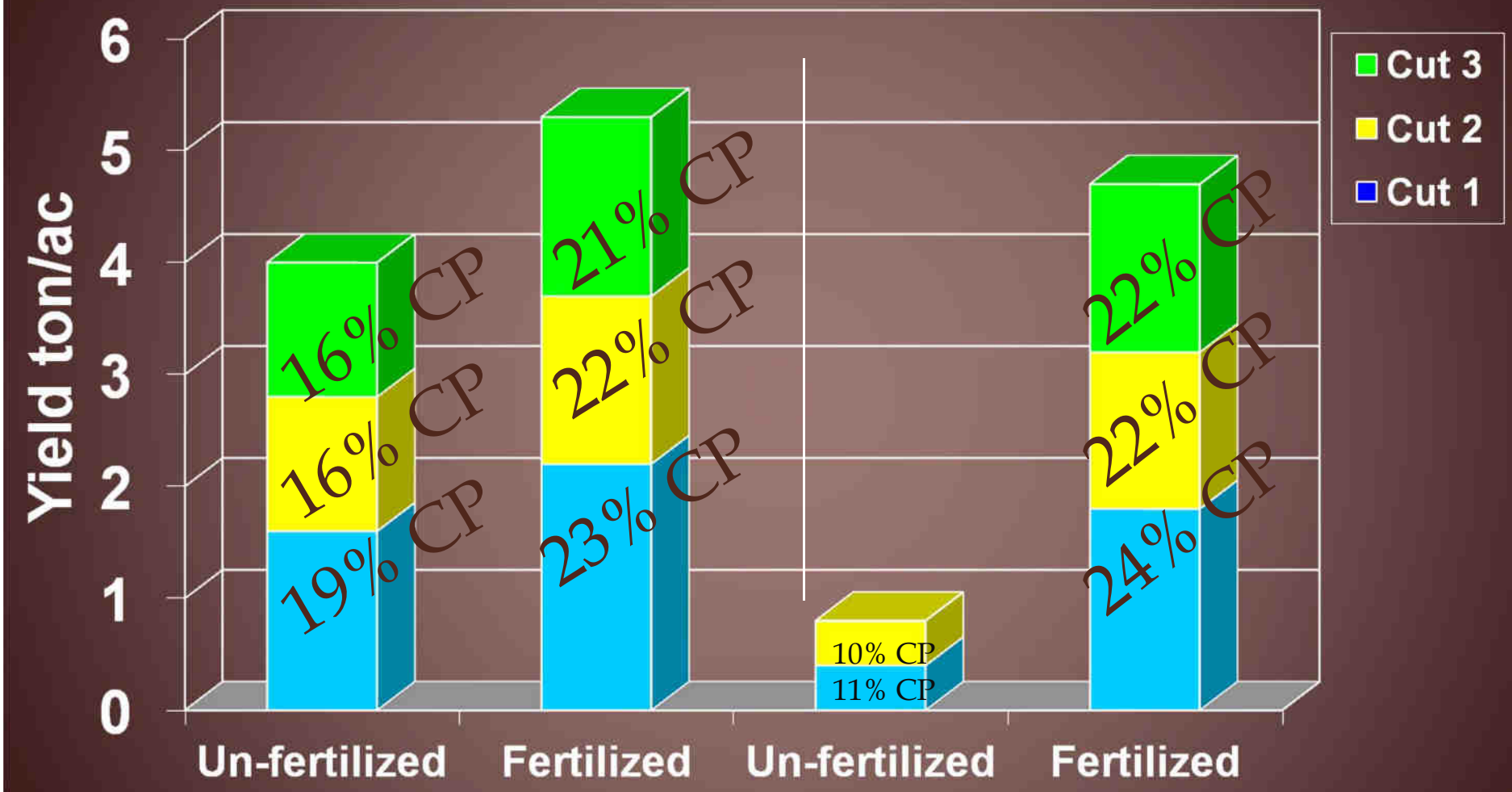
Soil pH	Buffer pH	Cation Exchange Capacity	% Base Saturation (Typical Range)				
			% Ca	% Mg	% K	% Na	% H
0-6" 8.0 6-24" 8.3							

Crop 1: Many crops may respond to a starter application of P & K even on high soil tests. Crop Removal: P2O5 = 12 K2O = 45 AGVISE Broadcast guidelines will build P & K test levels to the high range over several years.

How often are forage fields sampled and tested?

a. Each field annually
b. Each field every 2-3 years
c. Each field once
d. Never

Alfalfa responds to fertilizer.

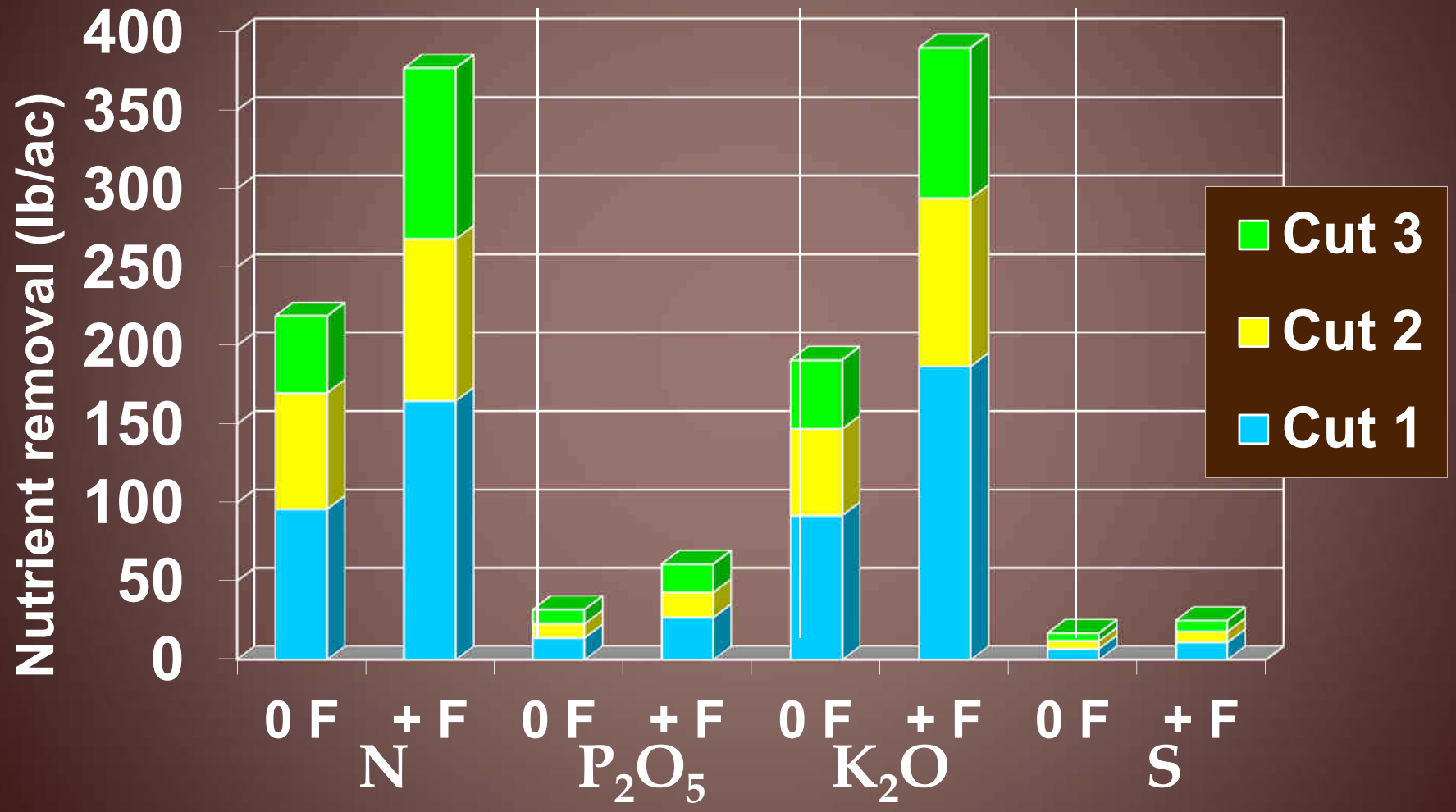


5 yr-ave on <u>clay loam</u> soil
0 - 54 P_2O_5 - 27 K_2O - 27S

5 yr-ave on <u>sandy loam</u> soil
0 - 54 P_2O_5 - 107 K_2O - 27S

Bailey, MB

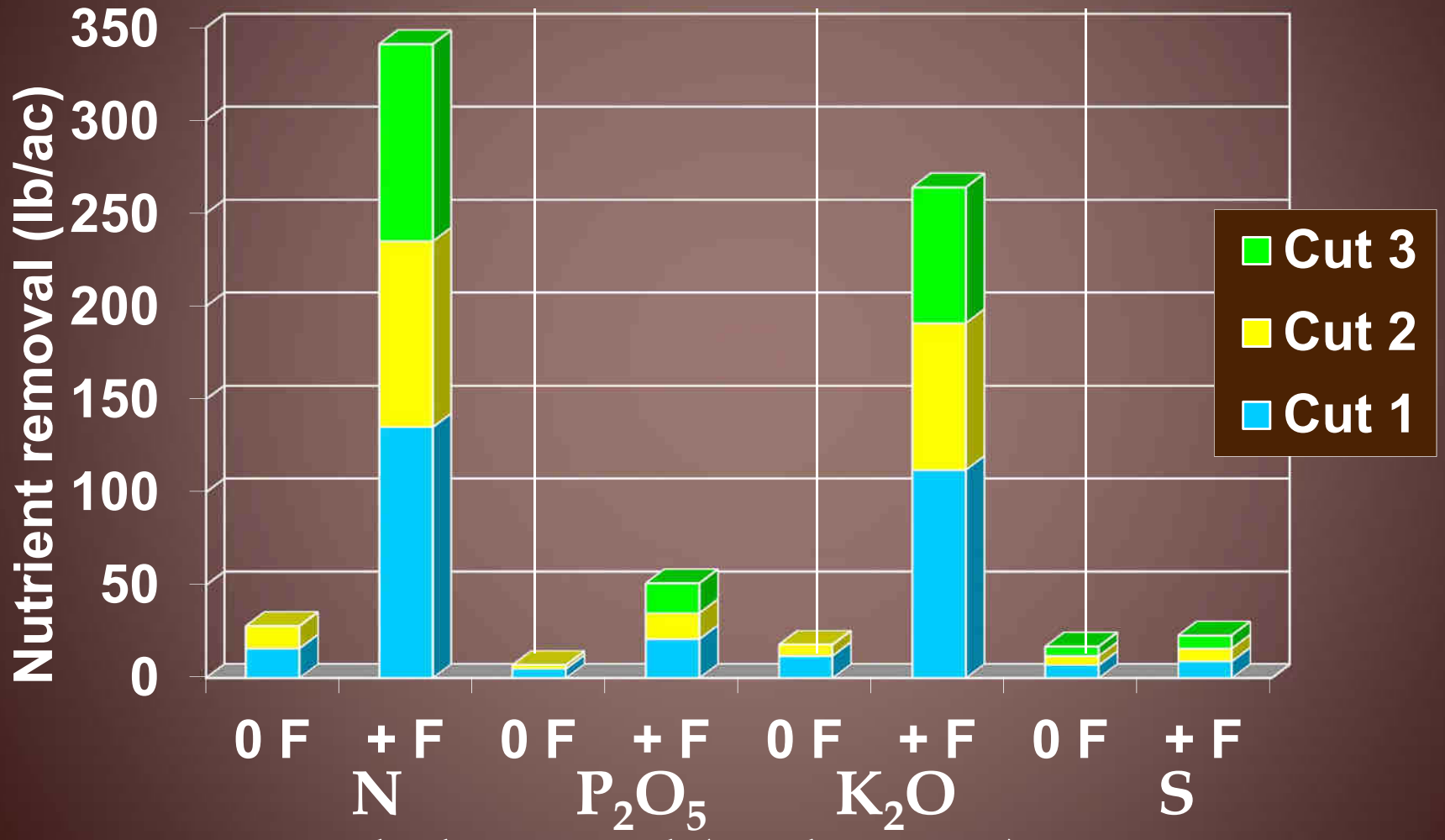
Nutrient uptake and removal by alfalfa – clay loam soil (4.0 vs 5.3 ton/ac)



5 yr-ave on sandy loam soil (Bailey, MB)

+F = fertilized with 0 - 54 P_2O_5 - 107 K_2O - 27S

Nutrient uptake and removal by alfalfa – sandy loam soil (0.8 vs 4.7 ton/ac)

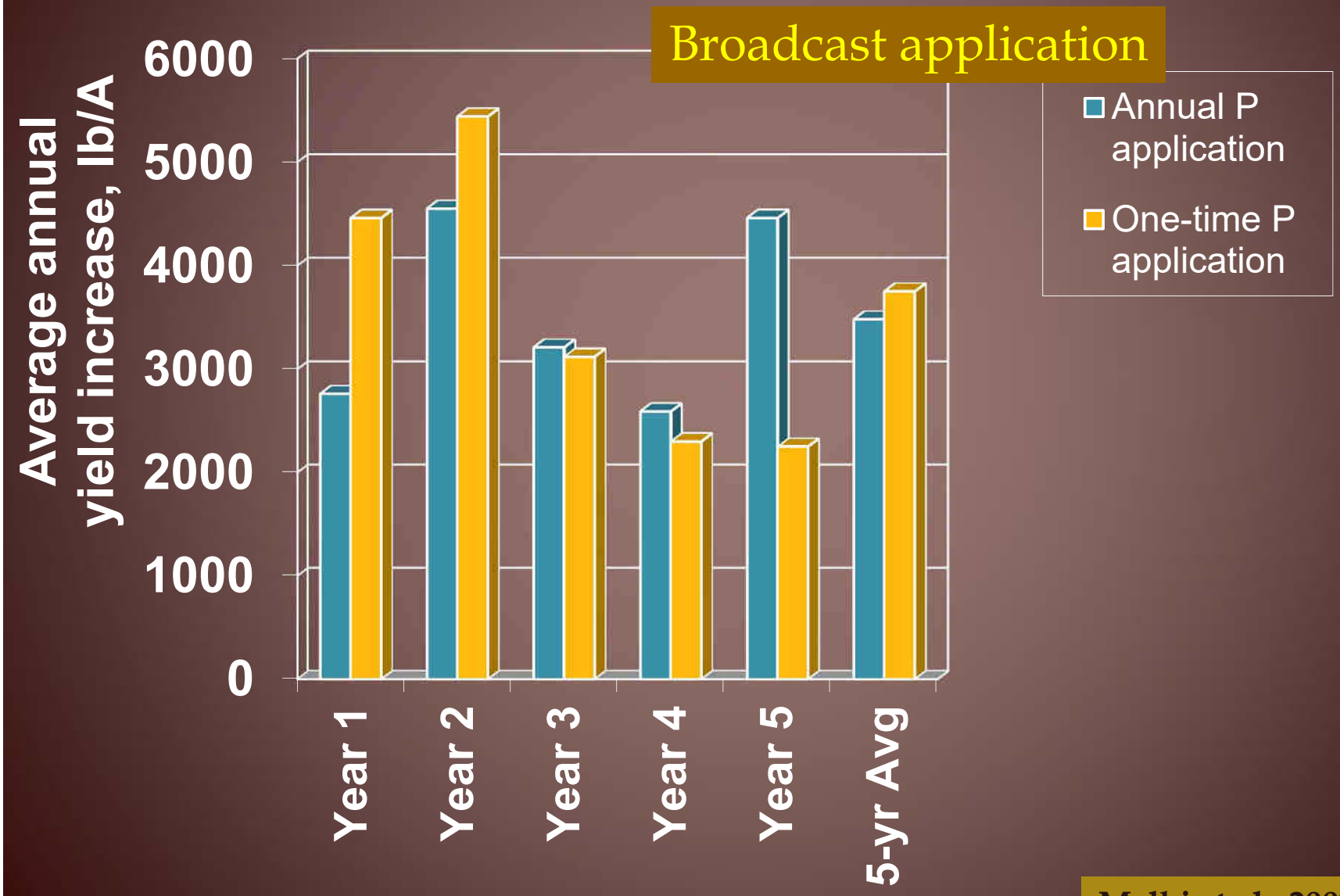


5 yr-ave on sandy loam soil (Bailey, MB)

+F = fertilized with 0 - 54 P_2O_5 - 107 K_2O - 27S

P "dosage" influences yield response in alfalfa

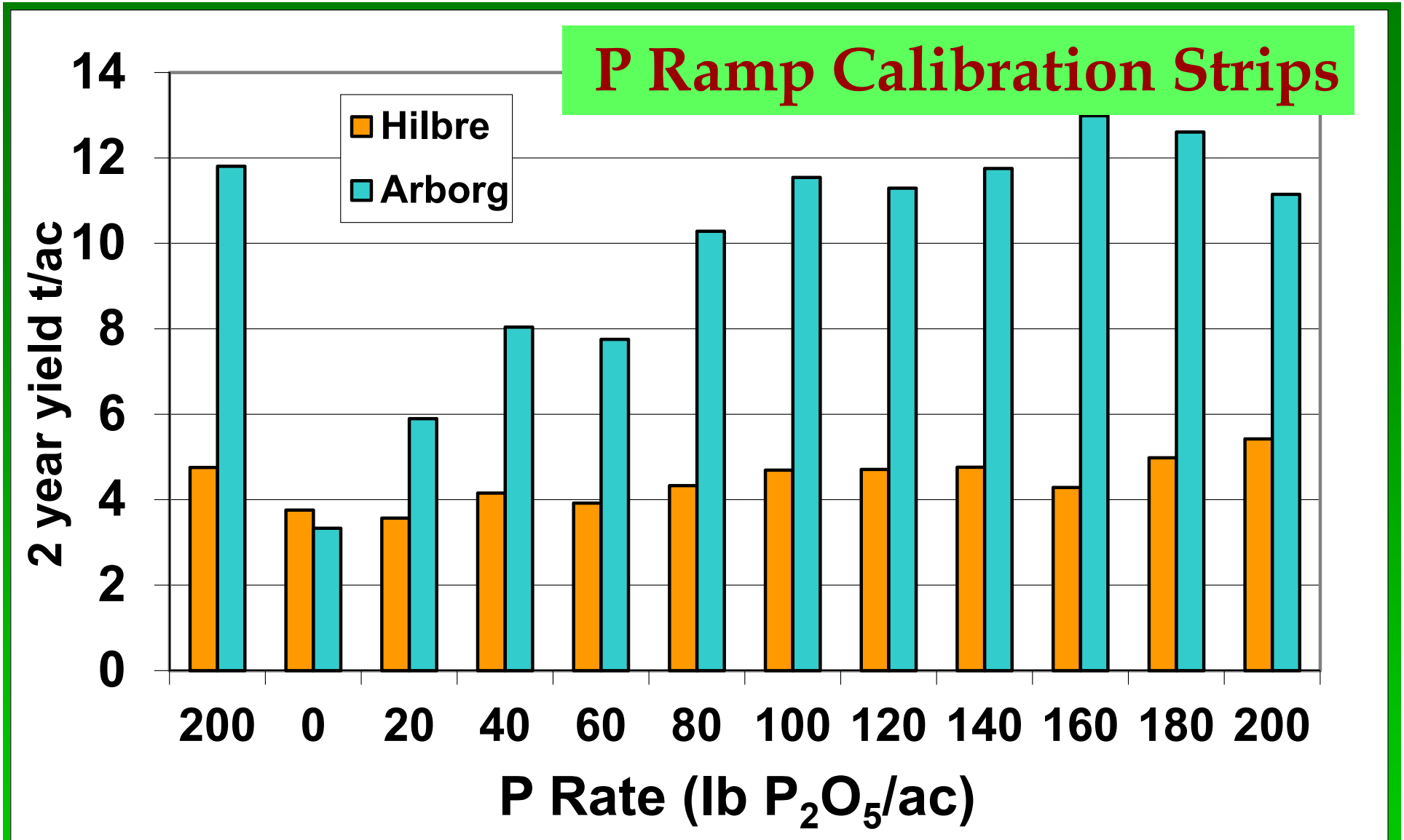
(**one-time** application vs. **annual** application)



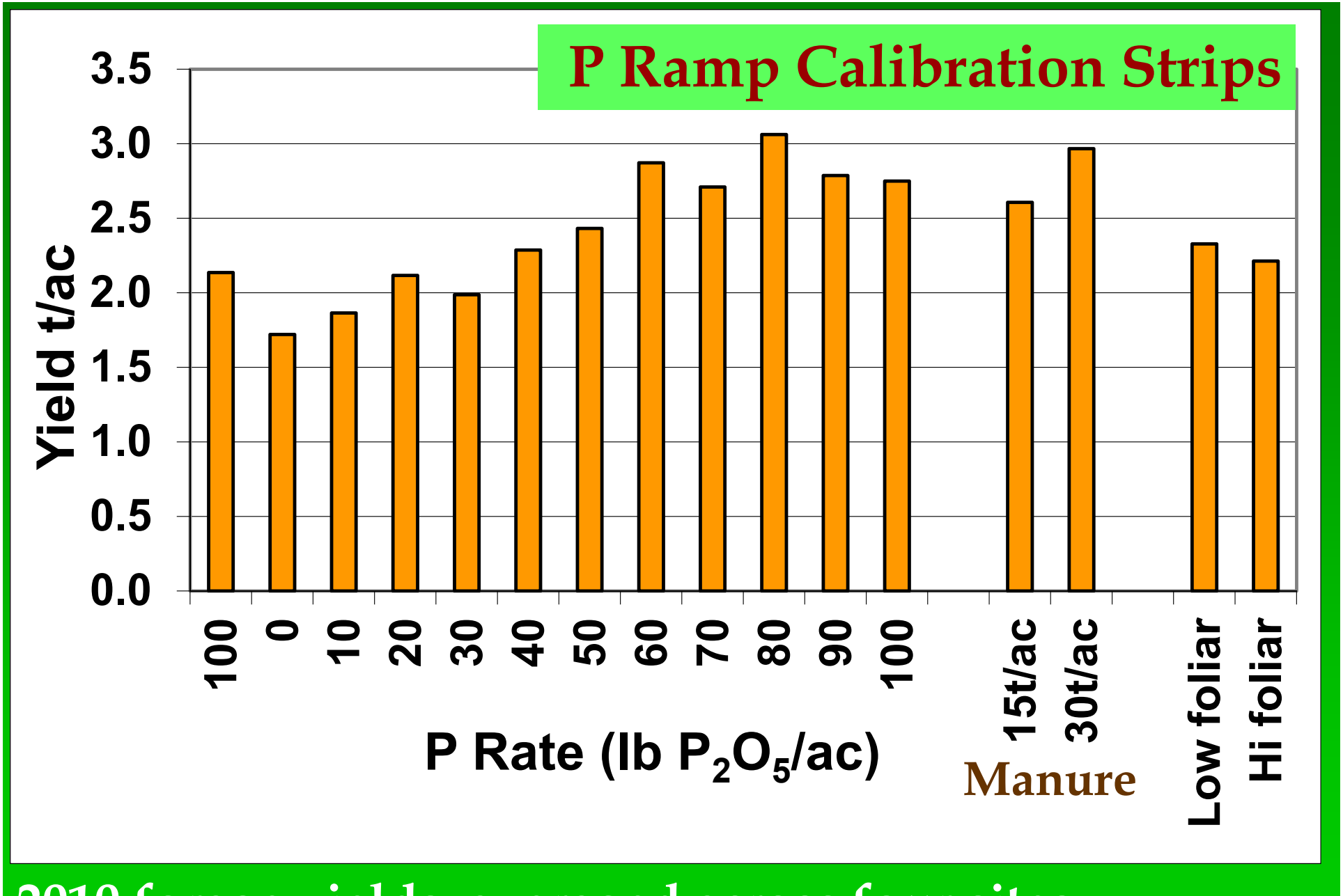
Malhi et al., 2001; Alberta

Fertility Indicator?

Fertility Indicator?



Cumulative alfalfa yields in 2009-10 at a responsive and a non-responsive site, following a single fertilization in October 2008.

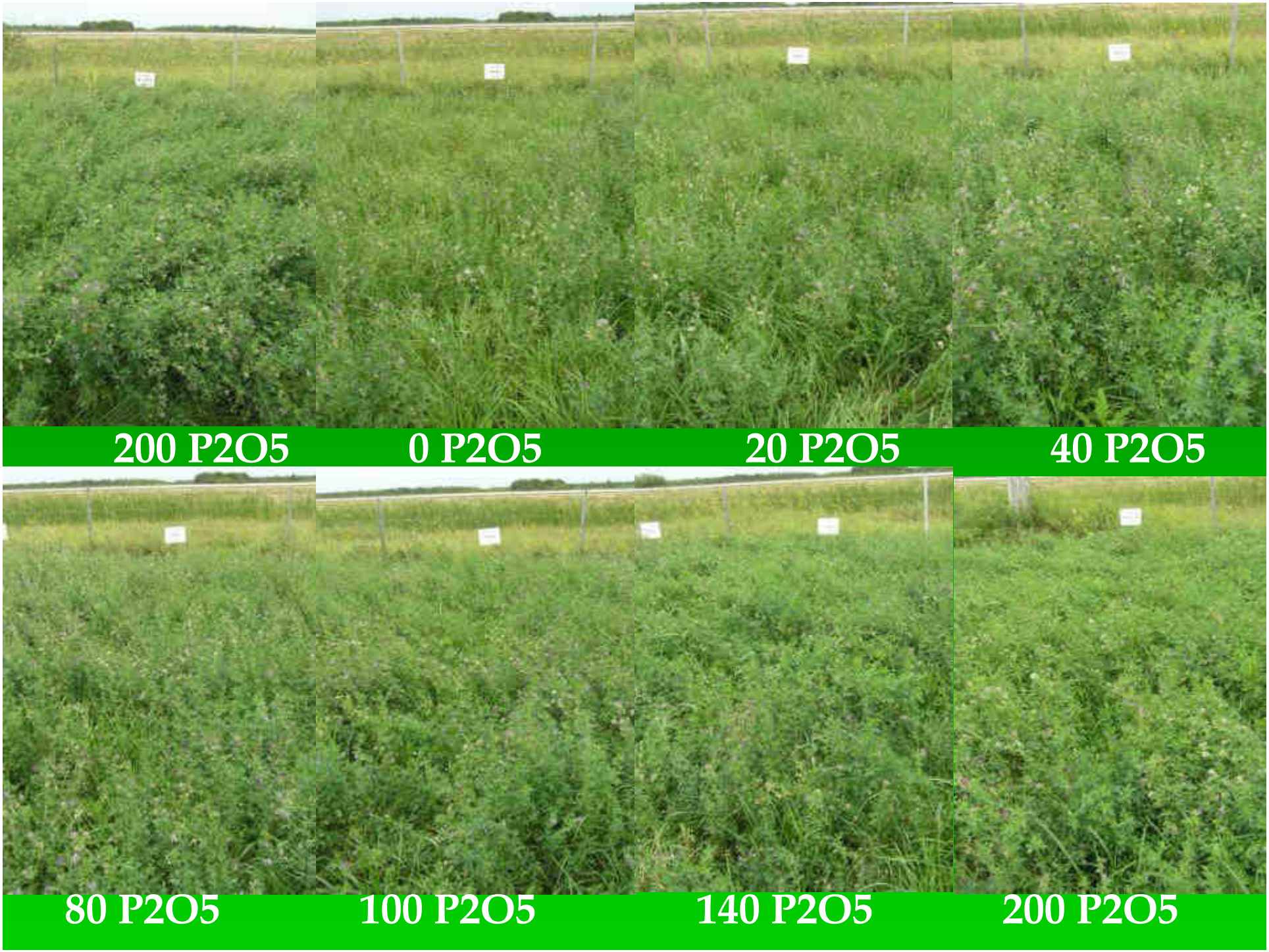


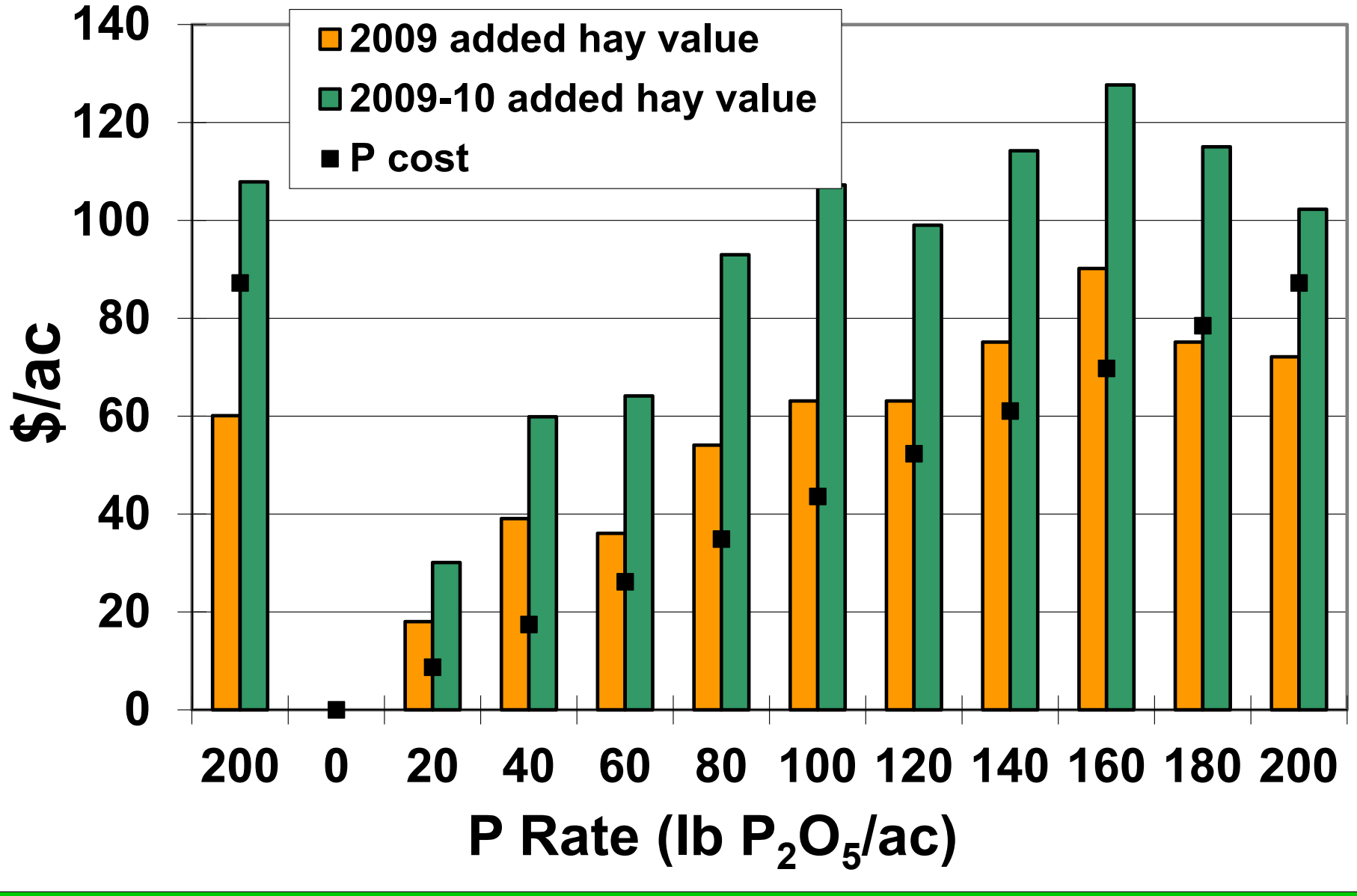
2010 forage yields, averaged across four sites, following fertilization in October 2009.

200 lb P_2O_5/ac vs 0 (Interlake P Ramps)

Heavy alfalfa
crop with lodging

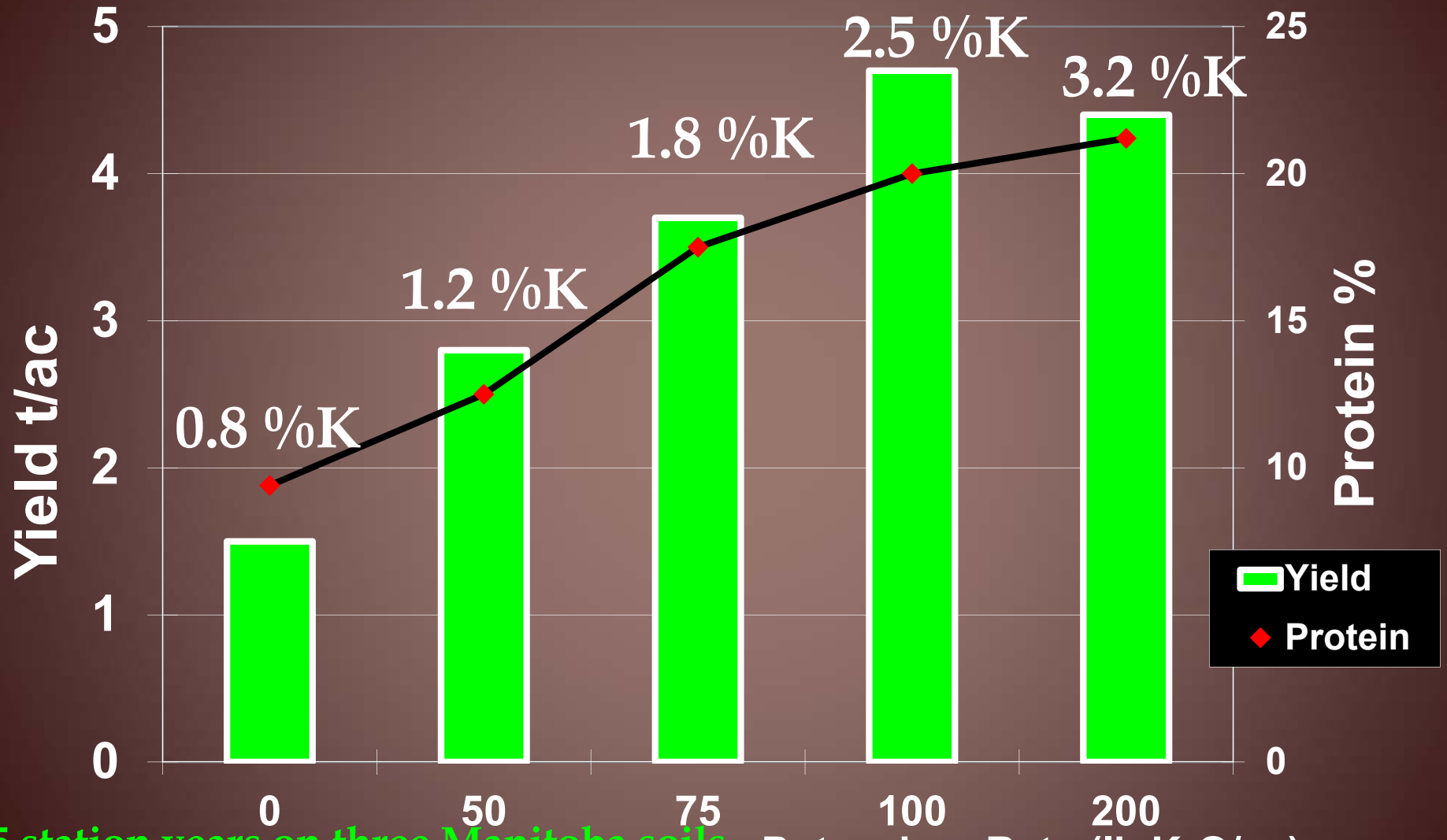
Predominantly
grass, bare ground


200 P2O5
0 P2O5
20 P2O5
40 P2O5
80 P2O5
100 P2O5
140 P2O5
200 P2O5



Did it pay to fertilize at Arborg? Yes, it did.

Fertilizing deficient fields with K increases alfalfa yield, protein and K content



5 station years on three Manitoba soils.
Initial soil K = 14-180 ppm.
Plots fertilized annually with 60 lb P2O5/ac and 30 lb S/ac.

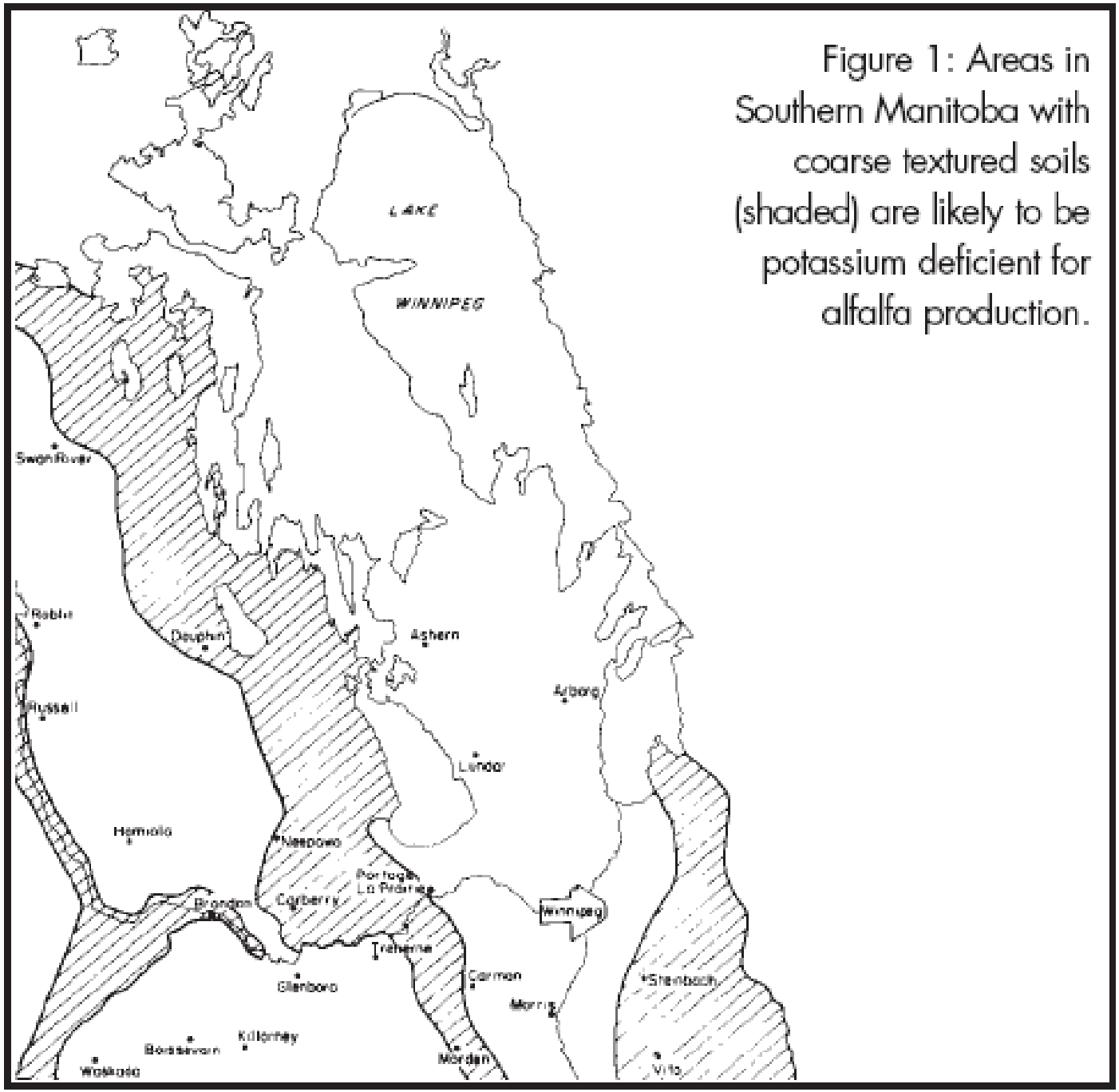
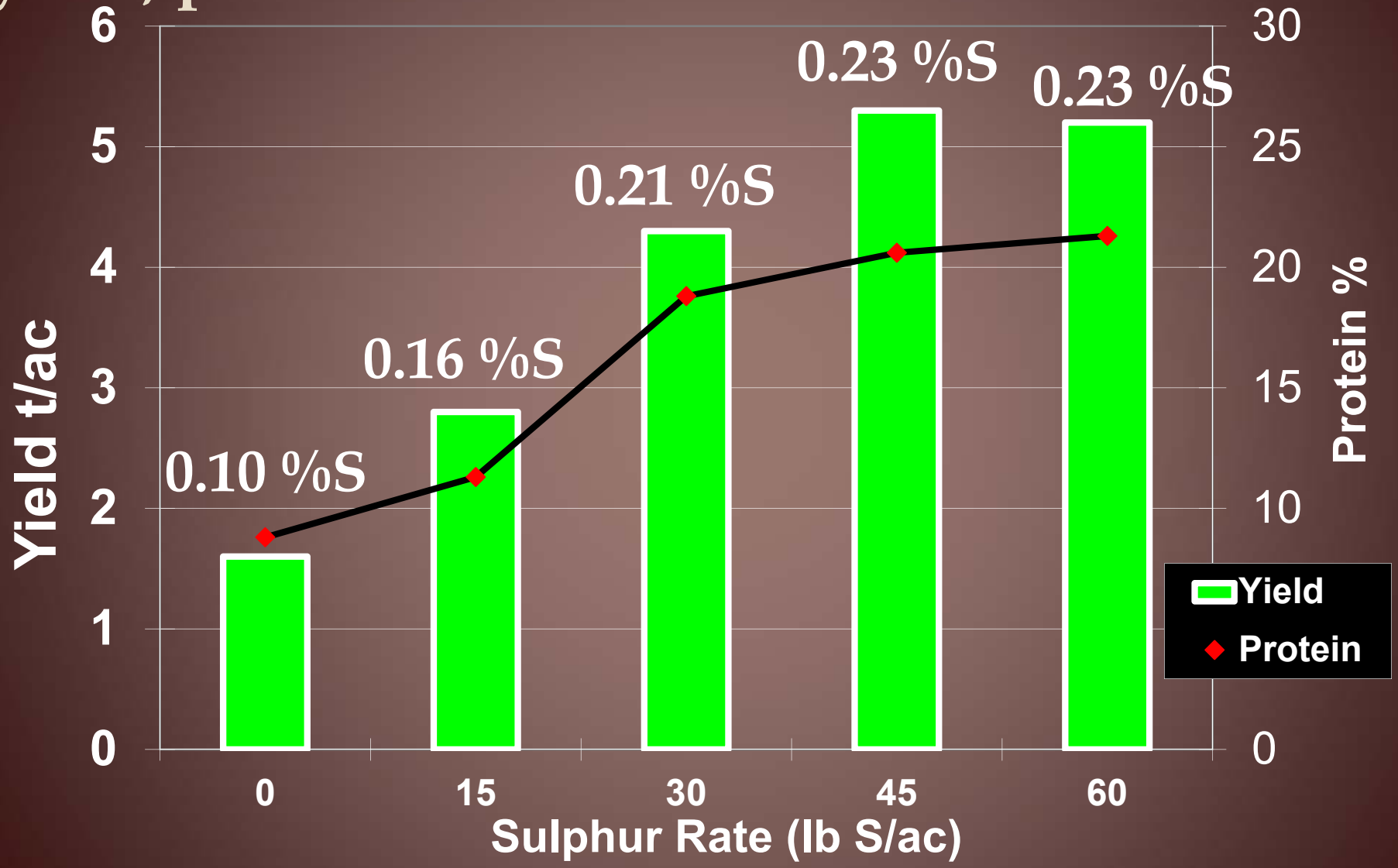


Figure 1: Areas in Southern Manitoba with coarse textured soils (shaded) are likely to be potassium deficient for alfalfa production.

Soil testing will indicate the presence of low K soils.

High yields of forages will deplete soils quicker than other crops and this should be monitored through soil sampling.

Applying S on deficient soils increases alfalfa yield, protein and S content



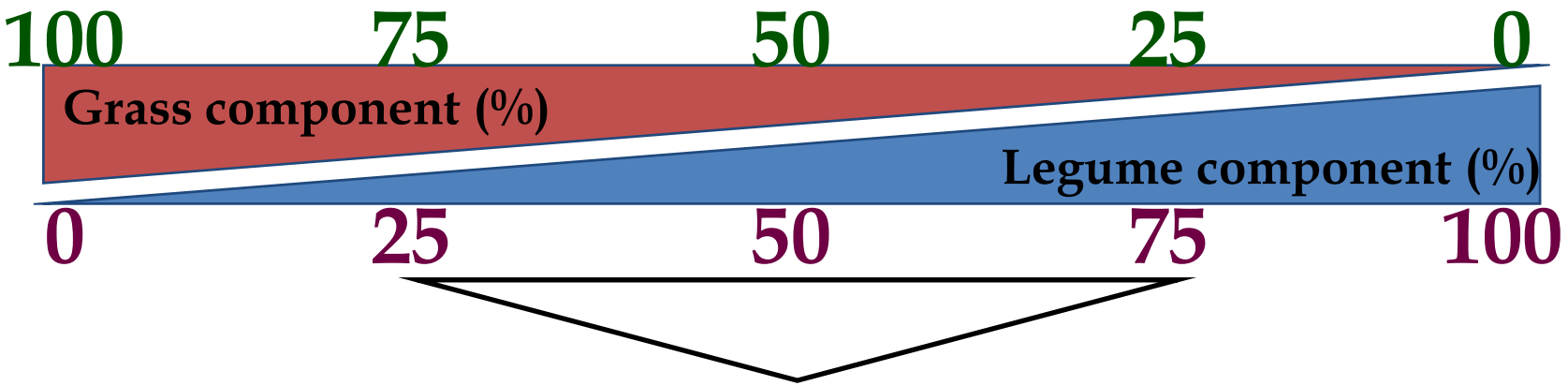
Five station years on a Grey Wooded soil in Manitoba.
Initial soil S = 13 lb/ac. Plots fertilized annually with 60 lb P_2O_5/ac and 30 lb K_2O/ac.

MASC Analysis
Risk Area 4 (Brandon), 2010-2014

	ALFALFA		ALFALFA-GRASS		GRASS	
	ACTUAL APPLIED	BALANCE	ACTUAL APPLIED	BALANCE	ACTUAL APPLIED	BALANCE
YIELD ton/ac	2.77		2.36		1.8	
N	13	-148	26	-83	40	-21
P2O5	28	-11	20	-8	19	1
K2O	28	-138	16	-104	30	-47
S	11	-6	9	-3	10	3

Nutrients in lb/ac

Fertilization Guidelines for Mixed Stands



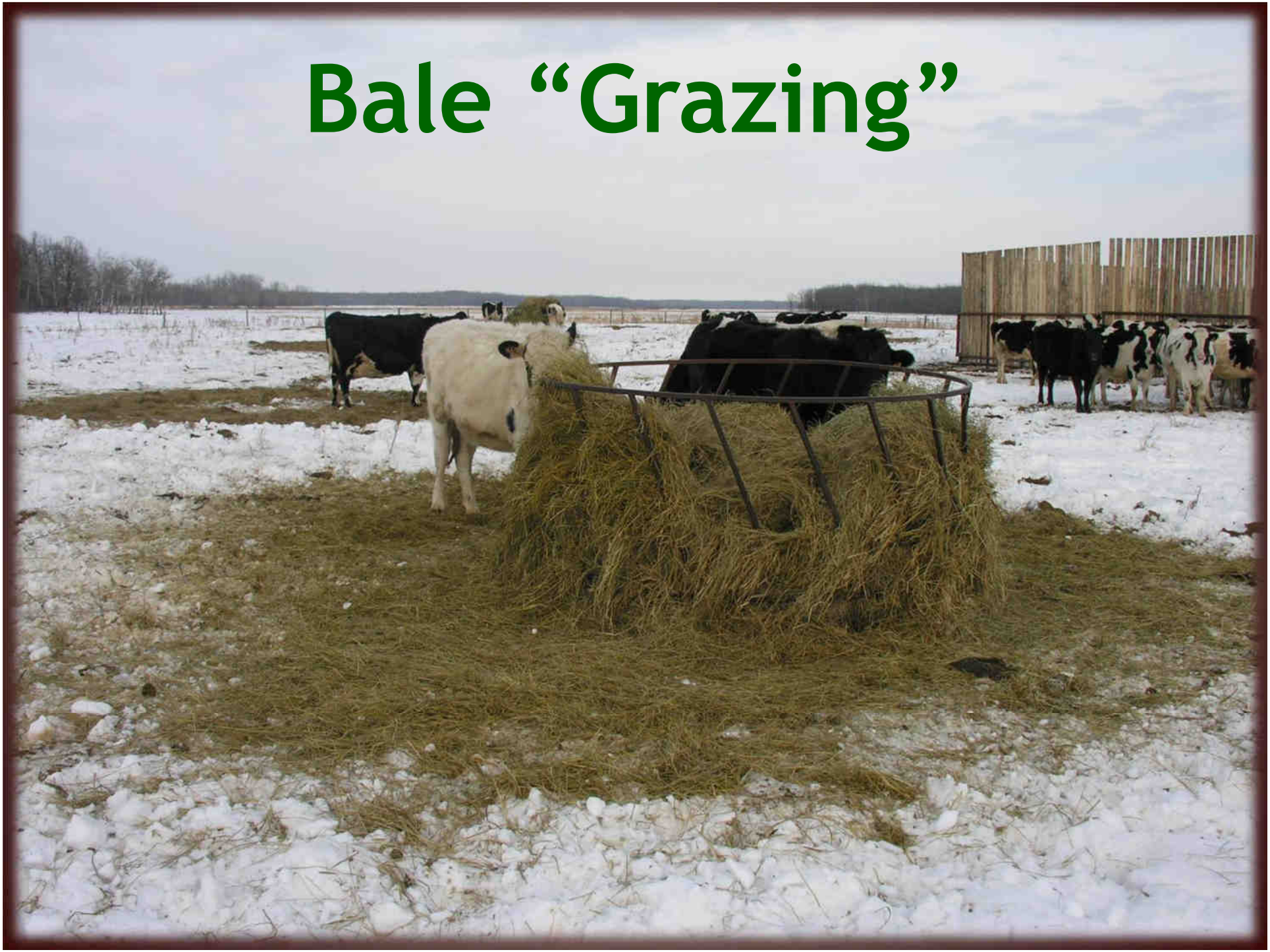
manage as a mixed stand

P & K - soil test

N - N rate for pure grass MINUS (% legume x N rate)

Source: Dr. L. Bailey, CDA, Brandon

Bale “Grazing”



What is the right rate?


Feed or Fertilizer?

30 feet between bales

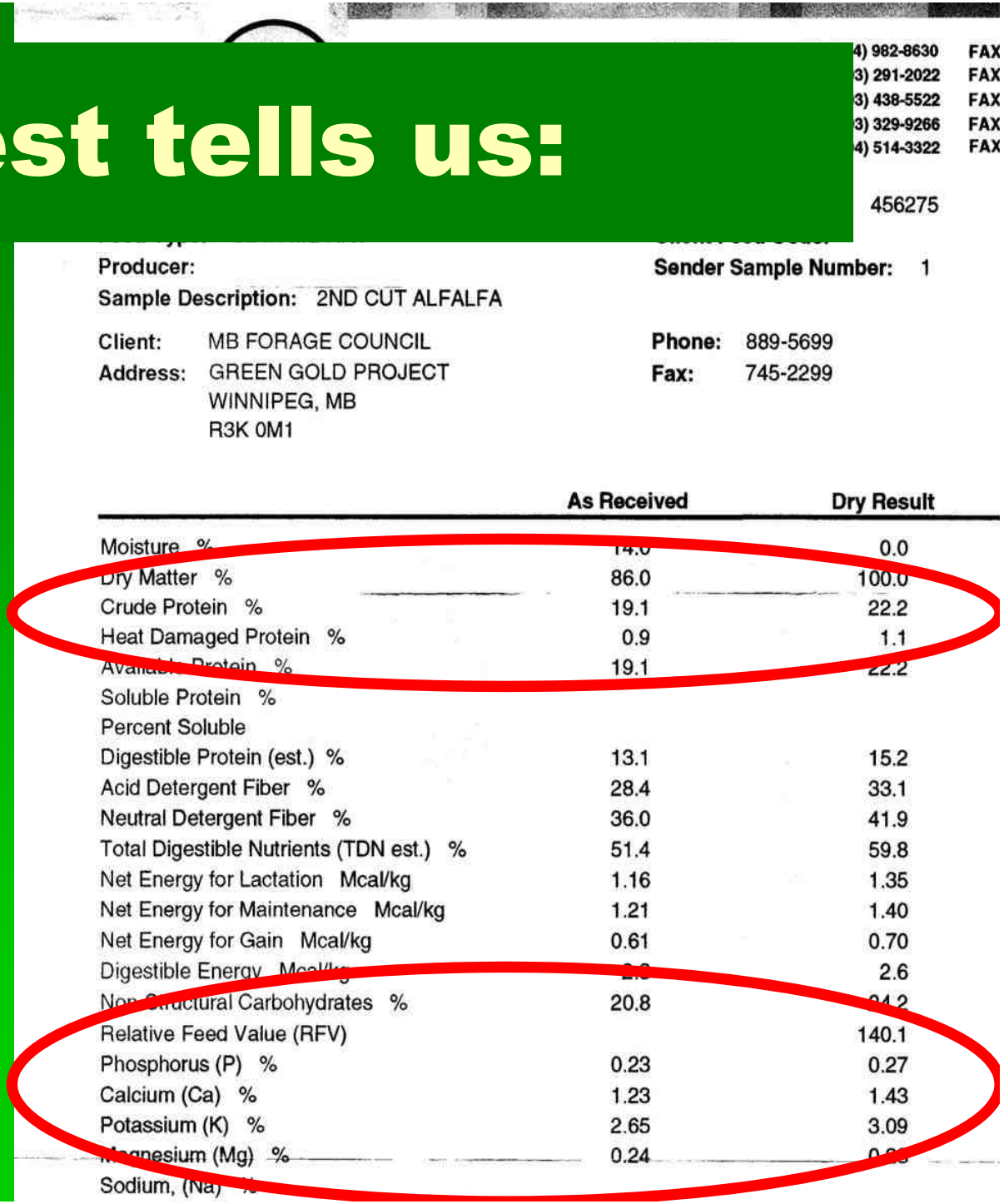
25 feet between bales

Corn Grazing

Swath Grazing

A forage test tells us:

- N content: > 2.5%
- = CP/6.25 = 3.55%
- P content : > 0.25
- K content: > 2.0



4) 982-8630 FAX
3) 291-2022 FAX
3) 438-5522 FAX
3) 329-9266 FAX
4) 514-3322 FAX

456275

Producer:
Sender Sample Number: 1
Sample Description: 2ND CUT ALFALFA

Client: MB FORAGE COUNCIL
Address: GREEN GOLD PROJECT
WINNIPEG, MB
R3K 0M1

Phone: 889-5699
Fax: 745-2299

	As Received	Dry Result
Moisture %	14.0	0.0
Dry Matter %	86.0	100.0
Crude Protein %	19.1	22.2
Heat Damaged Protein %	0.9	1.1
Available Protein %	19.1	22.2
Soluble Protein %		
Percent Soluble		
Digestible Protein (est.) %	13.1	15.2
Acid Detergent Fiber %	28.4	33.1
Neutral Detergent Fiber %	36.0	41.9
Total Digestible Nutrients (TDN est.) %	51.4	59.8
Net Energy for Lactation Mcal/kg	1.16	1.35
Net Energy for Maintenance Mcal/kg	1.21	1.40
Net Energy for Gain Mcal/kg	0.61	0.70
Digestible Energy Mcal/kg	2.3	2.6
Non-Structural Carbohydrates %	20.8	24.2
Relative Feed Value (RFV)		140.1
Phosphorus (P) %	0.23	0.27
Calcium (Ca) %	1.23	1.43
Potassium (K) %	2.65	3.09
Magnesium (Mg) %	0.24	0.28
Sodium, (Na) %		

Crop	P_2O_5 Removed (lb/bu or lb/ton)	Example Yield	P_2O_5 Removed (lb/ac)
Spring Wheat	0.59	40 bu/ac	23 (21-26) *
Oats	0.26	100 bu/ac	26
Canola	1.04	35 bu/ac	41
Flax	0.65	24 bu/ac	15
Barley grain	0.42	80 bu/ac	34
Barley silage	11.8	4.5 tons/ac	53
Corn grain	0.44	100 bu/ac	44 (39-48)
Corn silage	12.7	6 tons/ac	63

*NOTE: these values are the mid-points of ranges

Crop	P_2O_5 Removed (lb/bu or lb/ton)	Example Yield	P_2O_5 Removed (lb/ac)
Sunflower	0.32	50 bu/ac	16*
Edible beans	0.014	1,800 lb/ac	25
Soybeans	0.84	35 bu/ac	29
Peas	0.7	50 bu/ac	35
Potatoes	1.85	20 tons/ac	37
Alfalfa hay	13.8	5 tons/ac	69
Grass hay	10.0	3 tons/ac	30

* NOTE: these values are the mid-points of ranges

Manitoba Fertilizer Recommendations based on soil tests

Appendix Table 17. Phosphorus recommendations for field crops based on soil test levels and placement[28].

FERTILIZER PHOSPHATE (P_2O_5) RECOMMENDED (lb/ac)																
Soil Phosphorus (sodium bicarbonate or Olsen P test)			Cereal	Corn Sunflower	Canola Mustard Flax		Buckwheat Fababeans		Potatoes		Peas Lentils Field beans[9] Soybeans[1]		Legume forages		Perennial grass forages	
ppm	lb/ac	Rating	S[1]	Sb[2]	B[3]	S[1]	B[3]	S[1]	B[3]	PPI[4]	B[3]	S[1]	seeding PPI[5]	Est. stand BT[6]	seeding PPI[5]	Est. stand BT[6]
0	0	VL	40	40	40	20	40	20	55	110	40	20	75	55	45	30
5	10	L	40	40	40	20	40	20	50	100	40	15	75	55	45	30
10	20	M	30	30	30	20	30	20	45	90	30	10	60	40	30	20
	25	M	20	20	20	20	20	20	40	80	20	10	50	35	20	15

For very low P soil = P removal of a 3-4 t/ac crop
For medium P test = P removal of a 2-3 t/ac crop
For high P test = P removal of <2 t/ac crop

RIGHT ***TIME***

One runoff mechanism at one time of year…

The other one at other times…

Current Radar

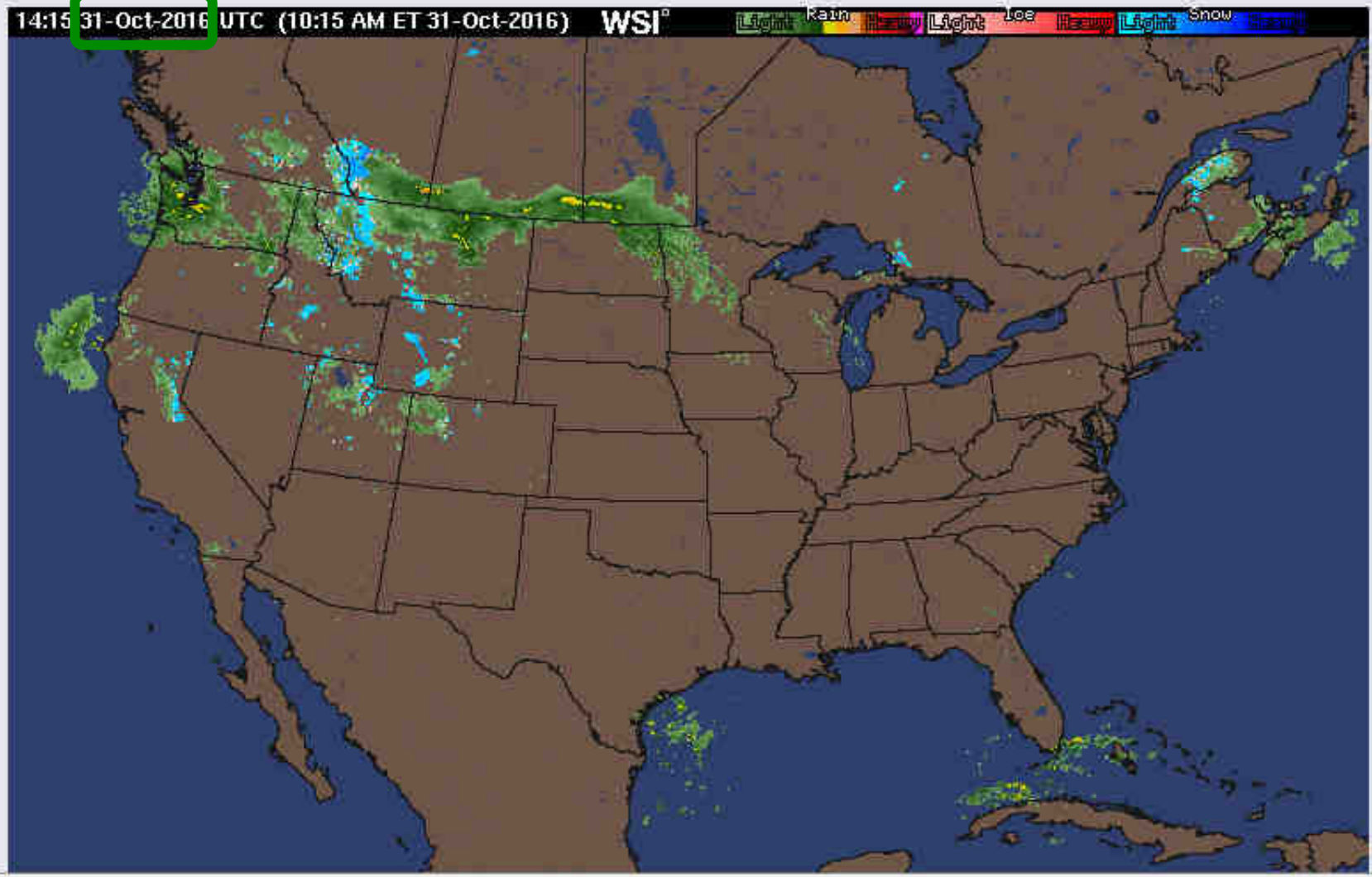
Current Radar

Region: United States

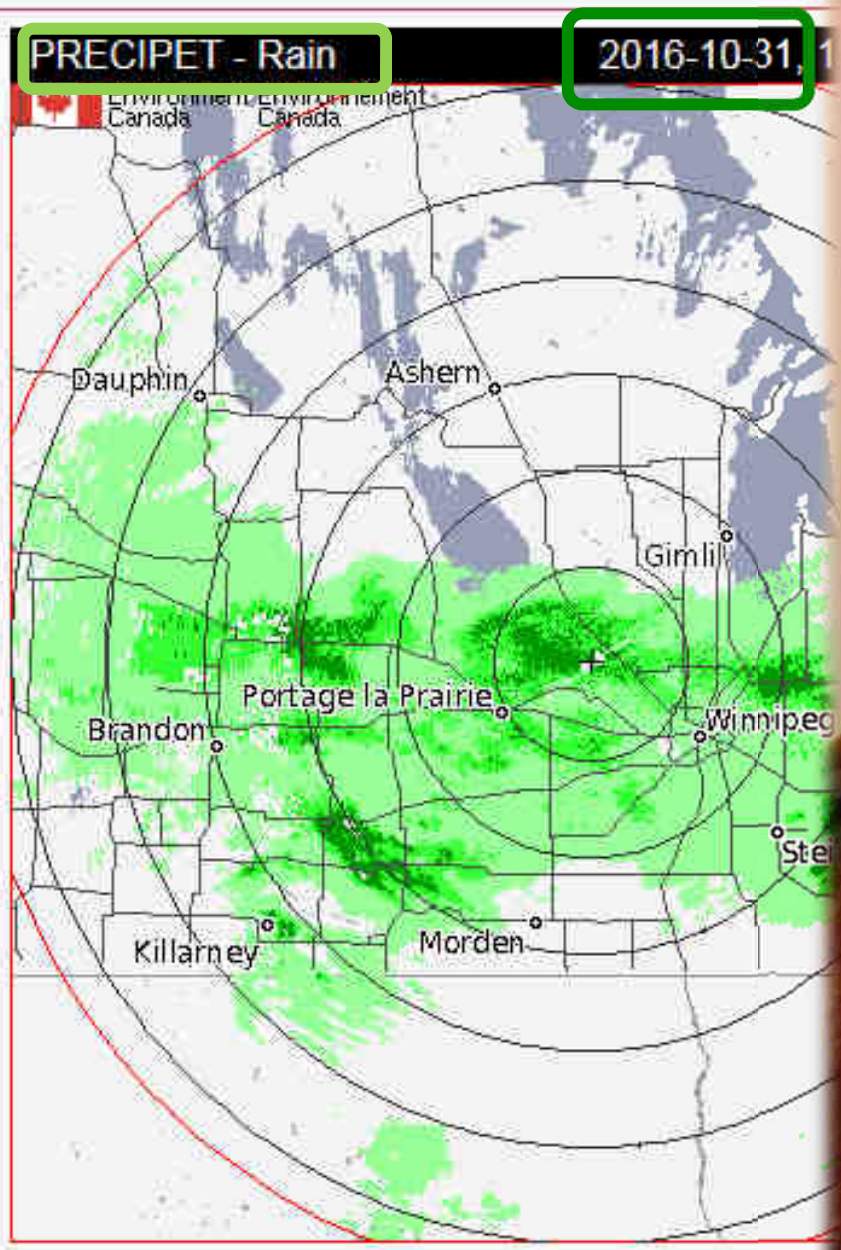
Pan & Zoom | Stop Animation

Toggle National and Regional Views

Click the blue-button above to toggle between National/World and Regional views. View persists until toggle back.
For adding explicit book-marks to directly access preferred weather maps, click here to visit our FAQ page.



Weather Radar - Woodlanc



Animation

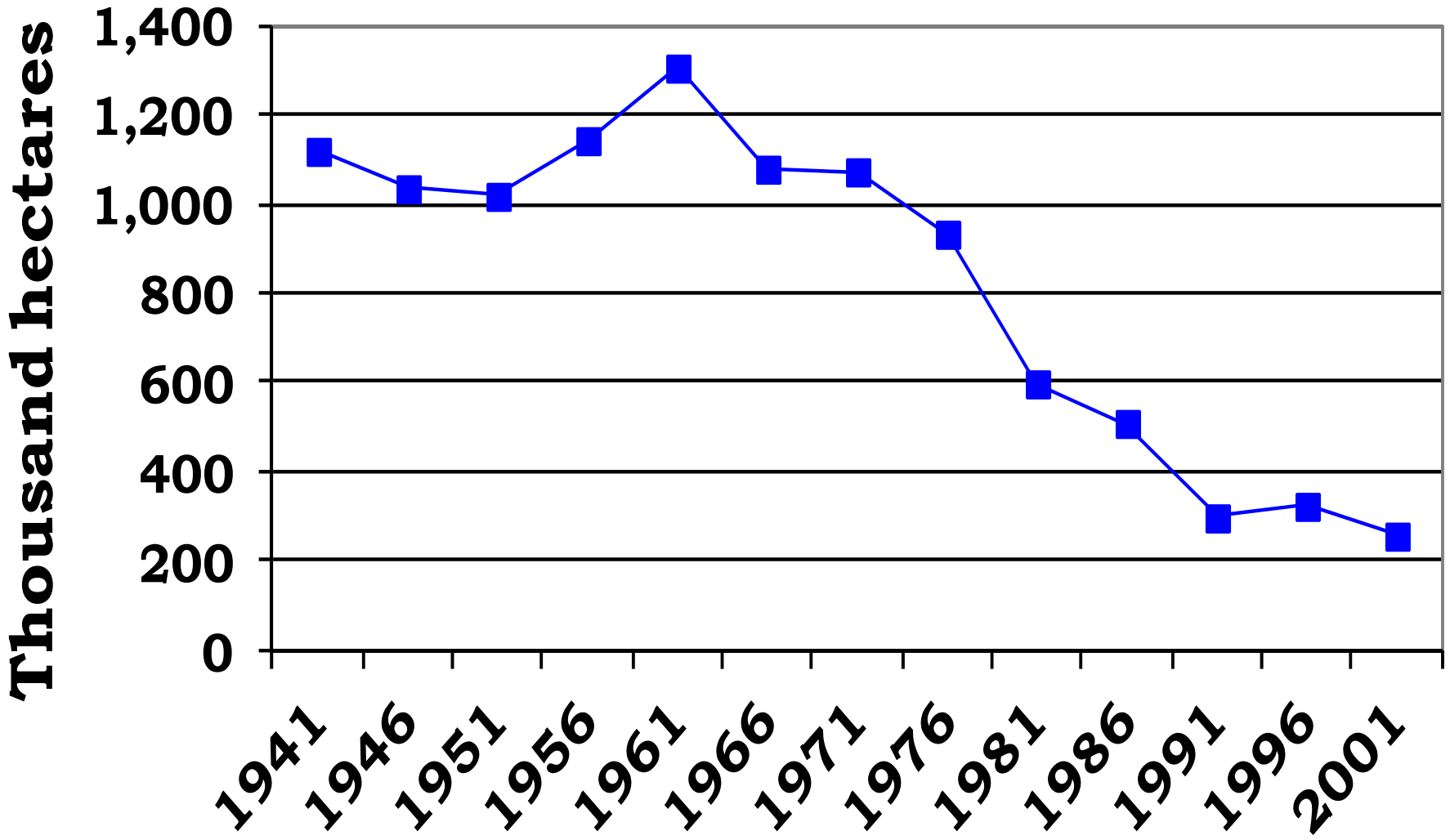
Water erosion does occur.

Topography can be a factor.

What is the practice?

Is it higher or lower risk?

Declining area of fallowed land in Manitoba

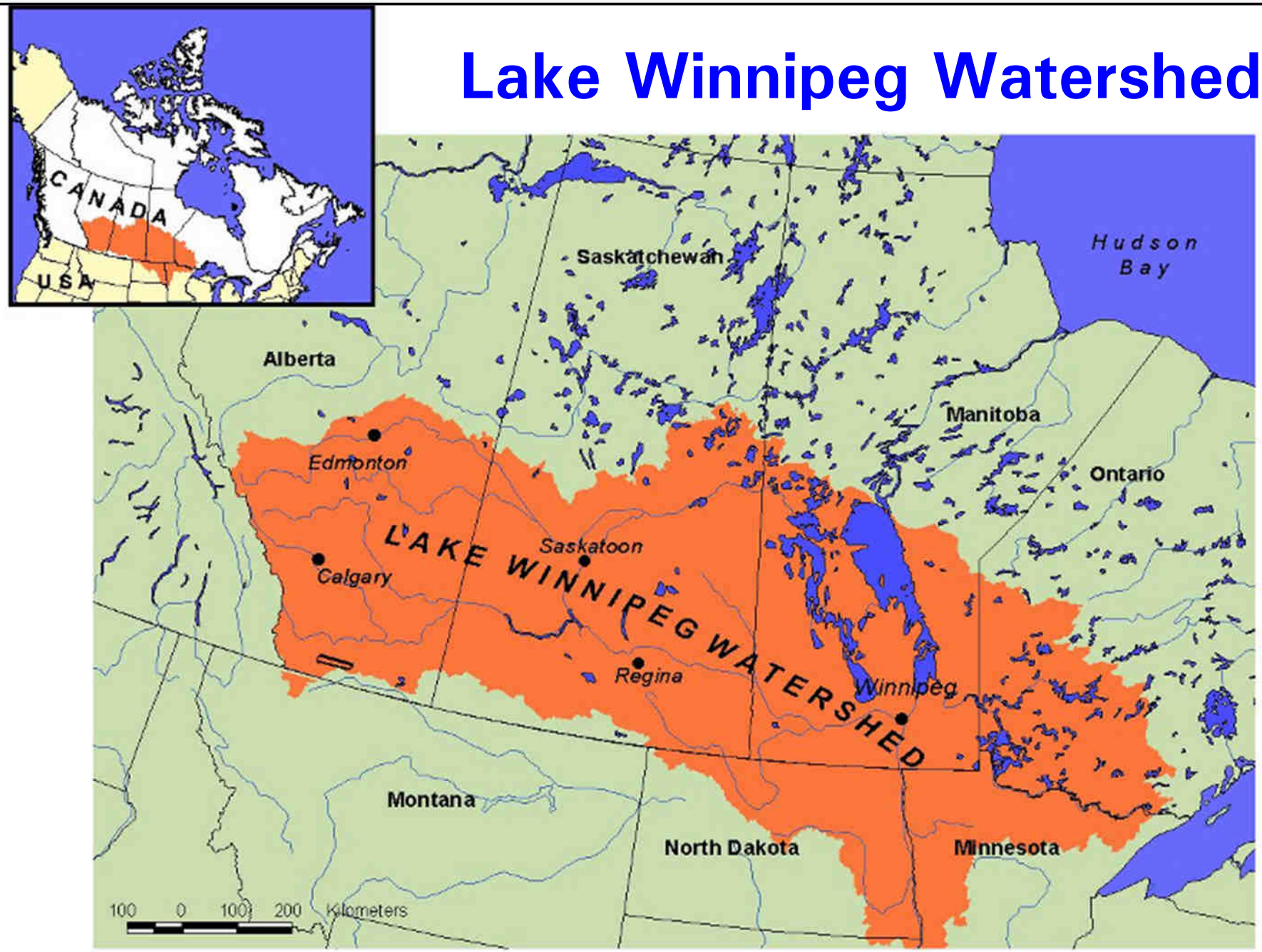


Stats Canada data through 2006

More typical over more acres?

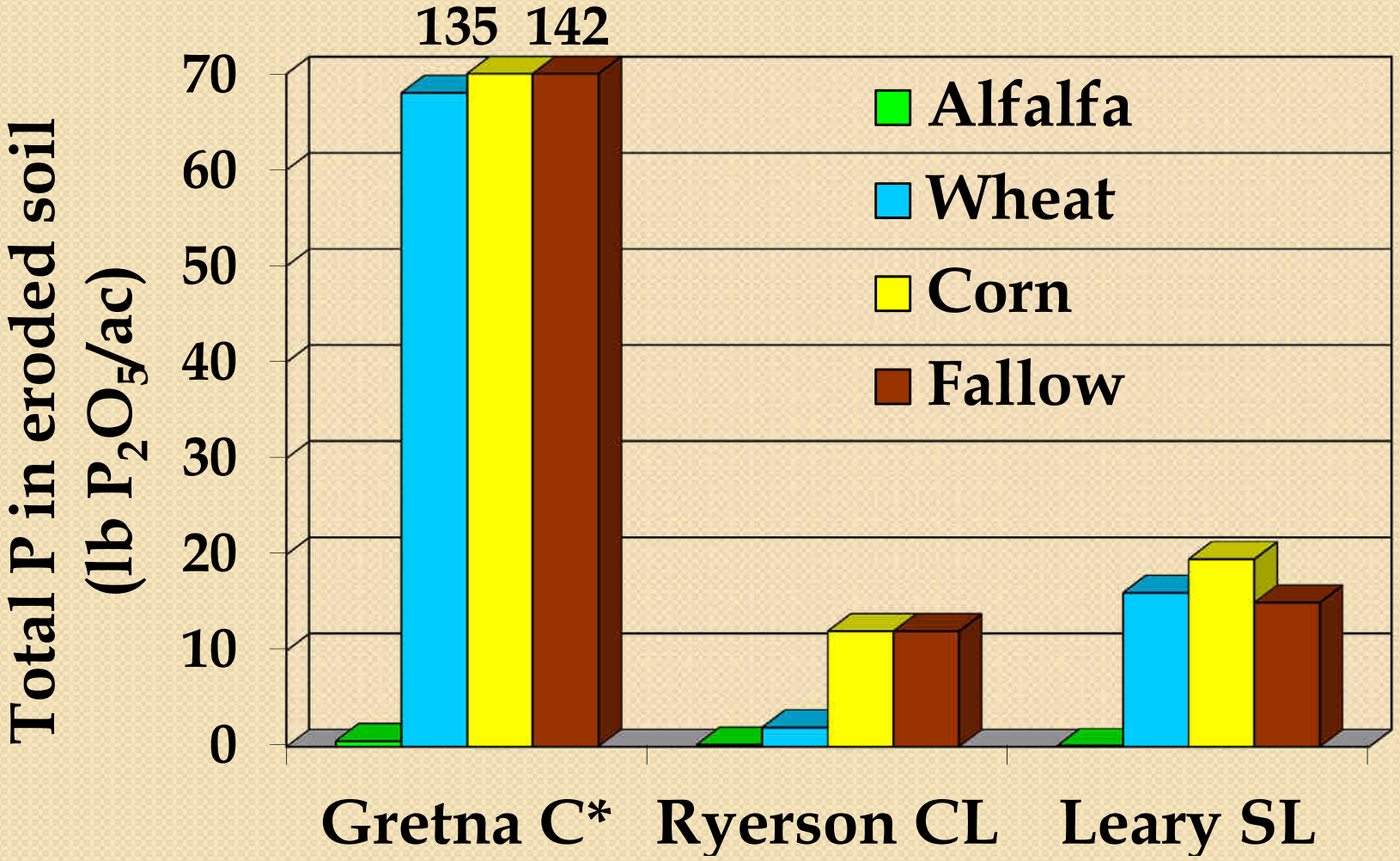
So what is dominant?

Lake Winnipeg Watershed



Loss of P in Erosion Sediment

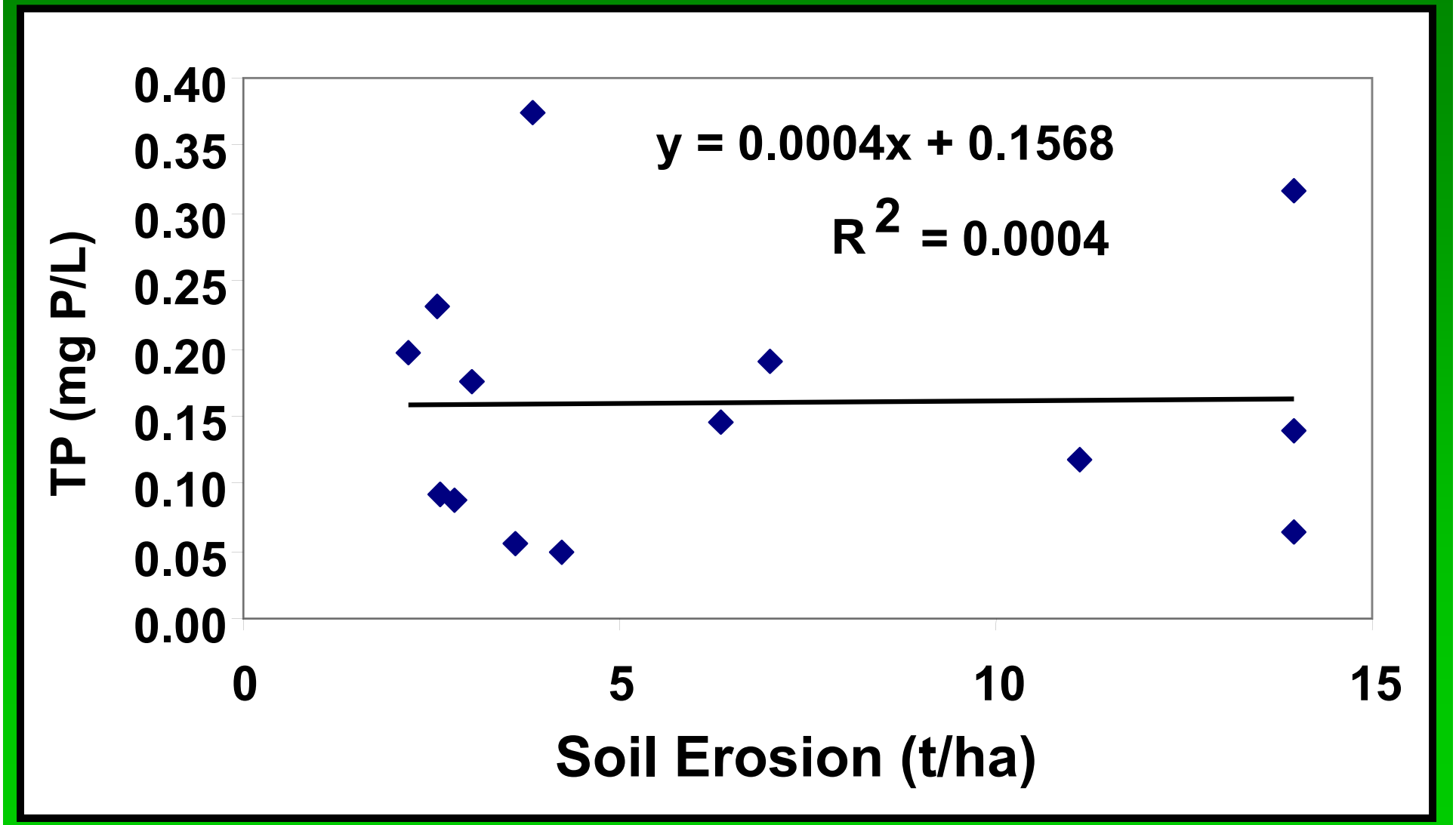
Three MB sites on 9% slopes, 3 yr average (1988-90)



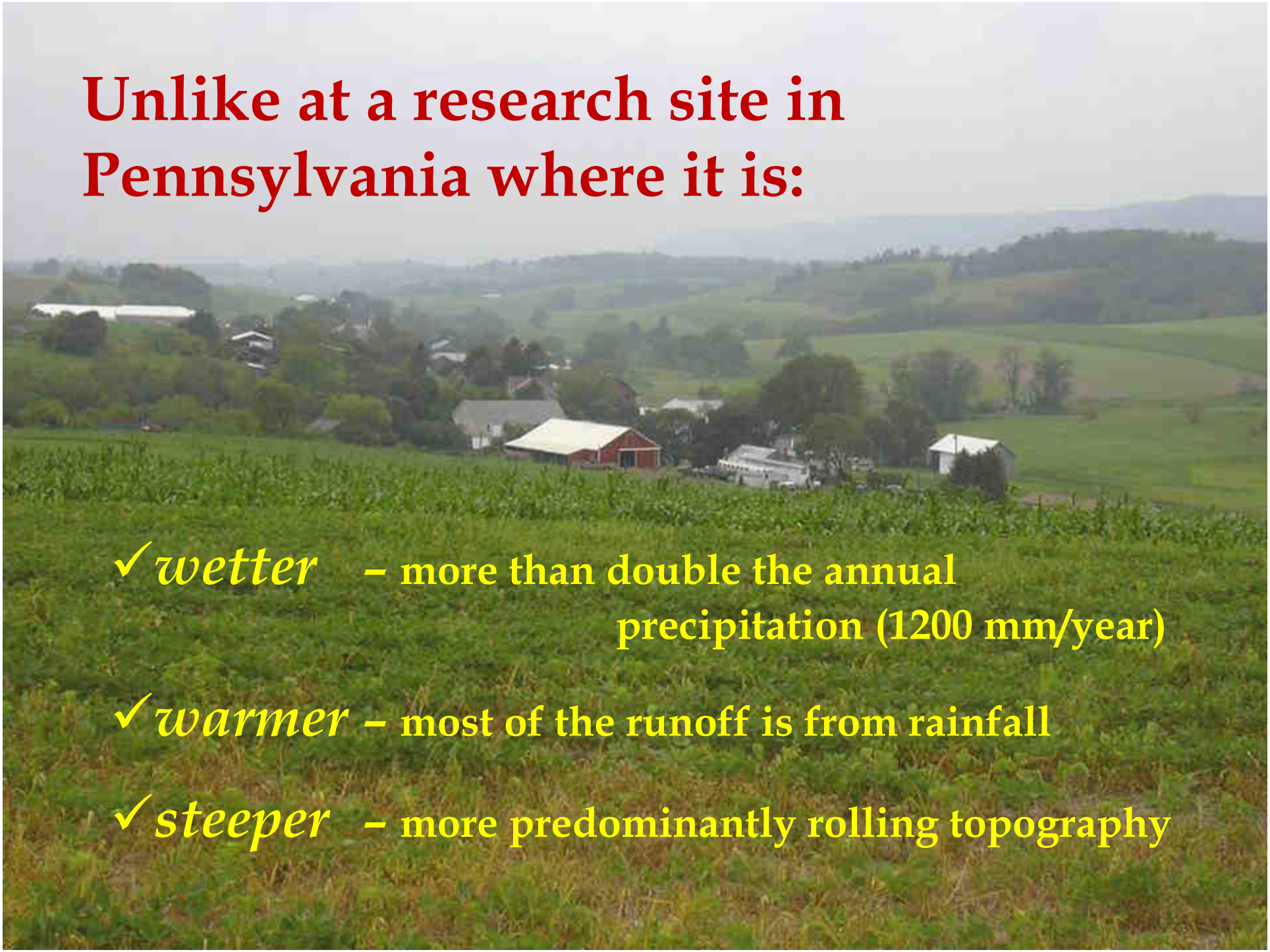
** Mostly caused by a single 4 inch rainfall event*

Hargrave and Shaykewich, 1991

Erosion risk found not to be related to river P concentrations in 14 regional Manitoba watersheds



Salvano and Flaten 2006



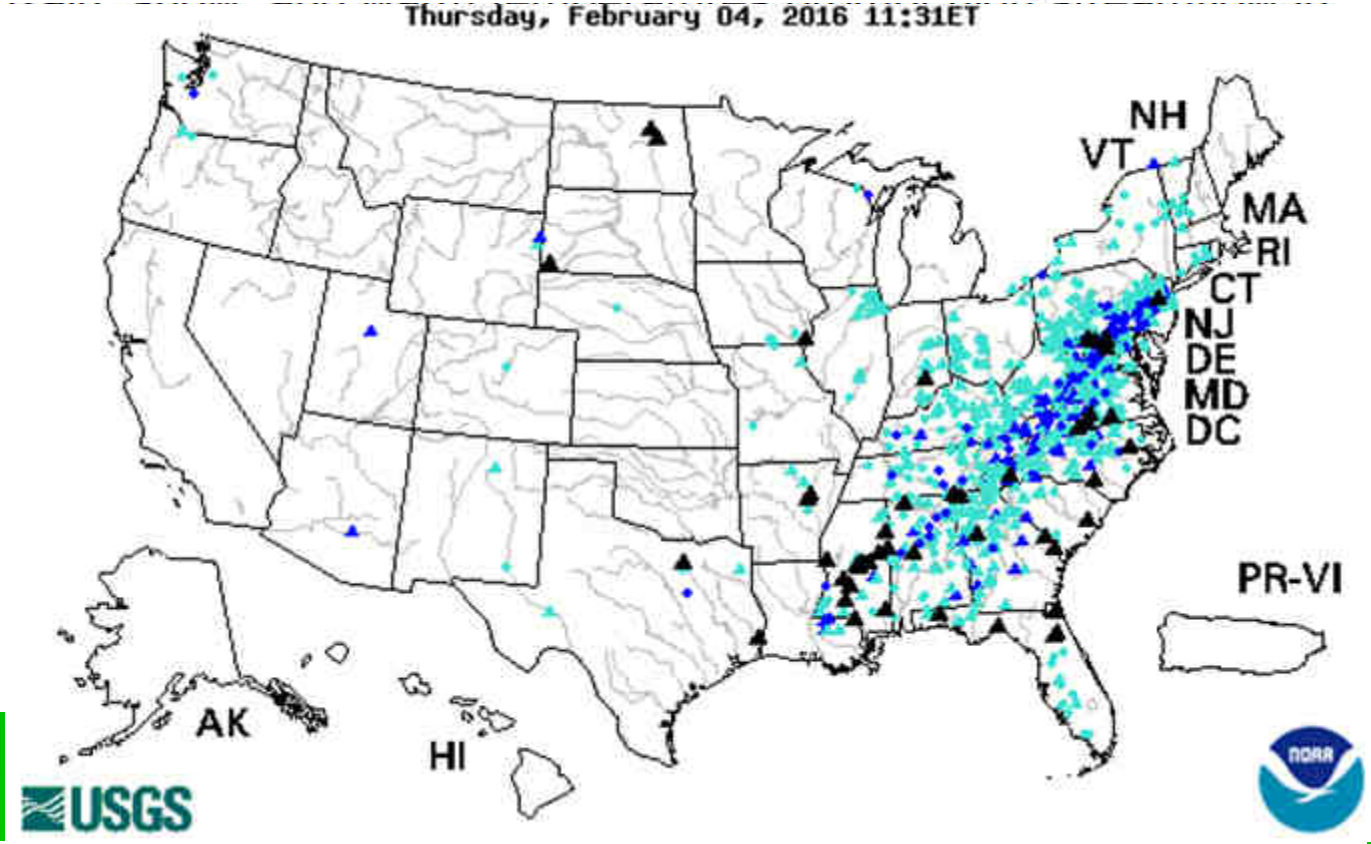
Unlike at a research site in Pennsylvania where it is:

- ✓*wetter* – more than double the annual precipitation (1200 mm/year)
- ✓*warmer* – most of the runoff is from rainfall
- ✓*steeper* – more predominantly rolling topography

USDA United States Department of Agriculture

Map of flood and high flow condition (United States)

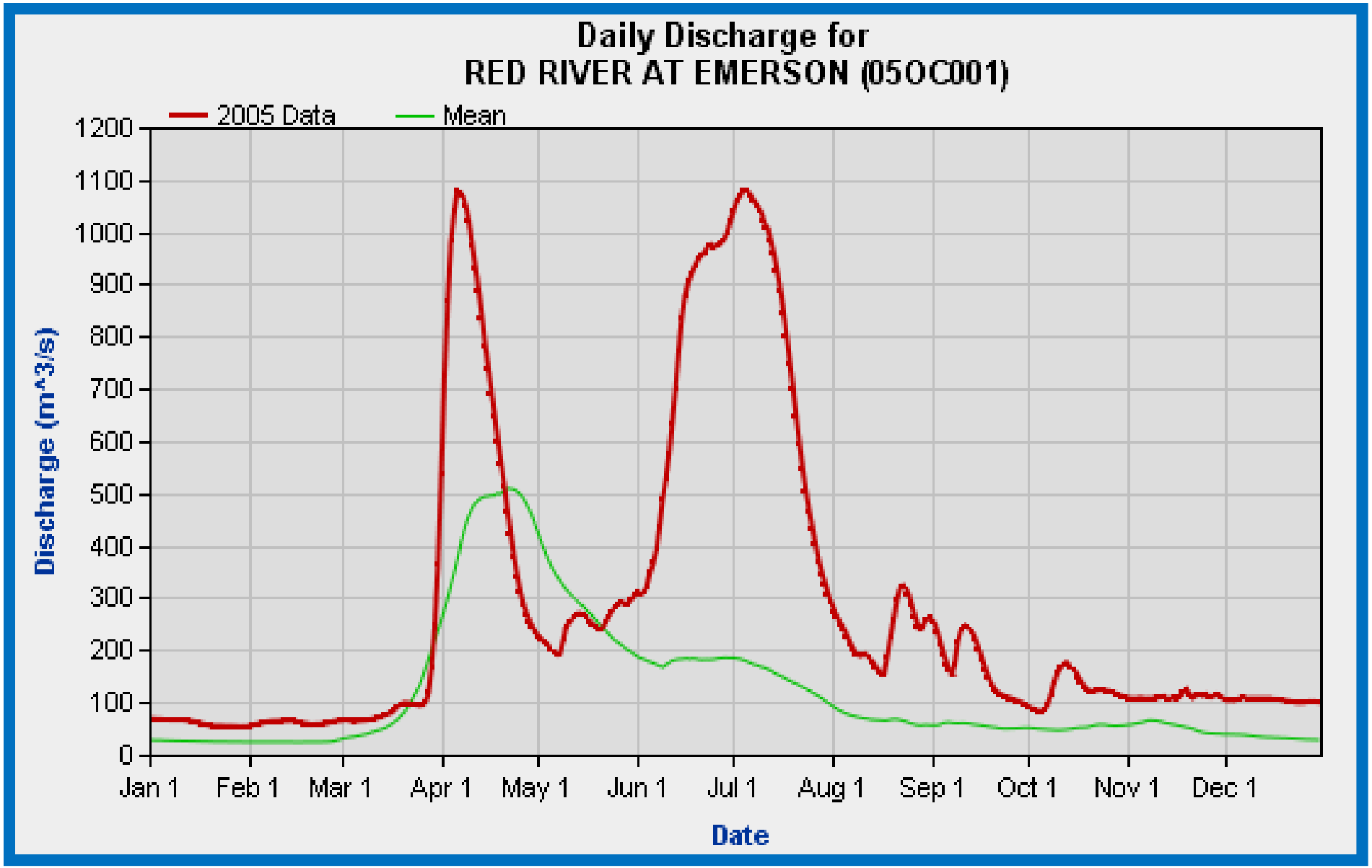
State or Water-Resources Regions



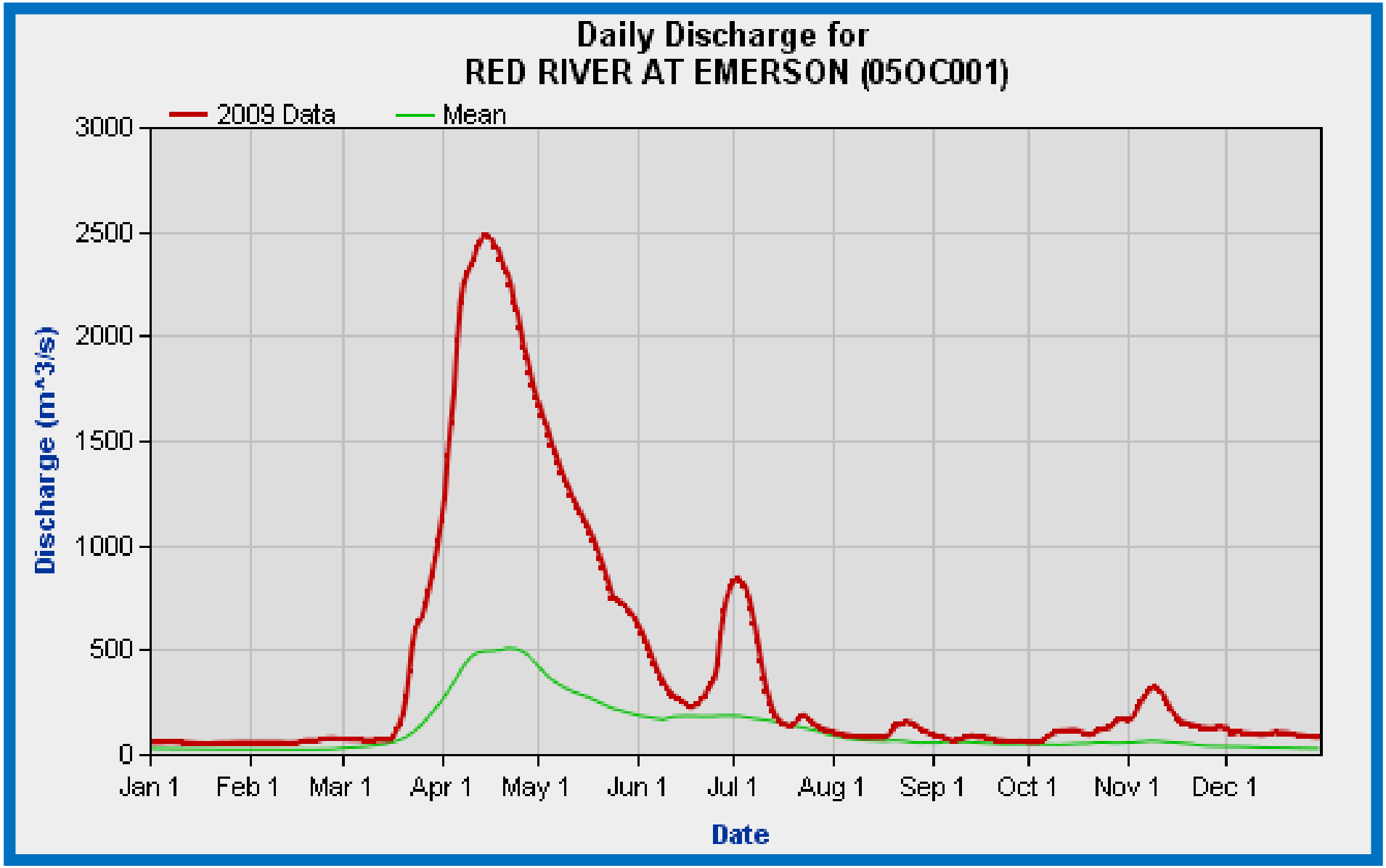
Explanation - Percentile classes		
95-98	>= 99	River above flood stage
△ Streamgage with flood stage	○ Streamgage without flood stage	

...it is just plain different here.

2005

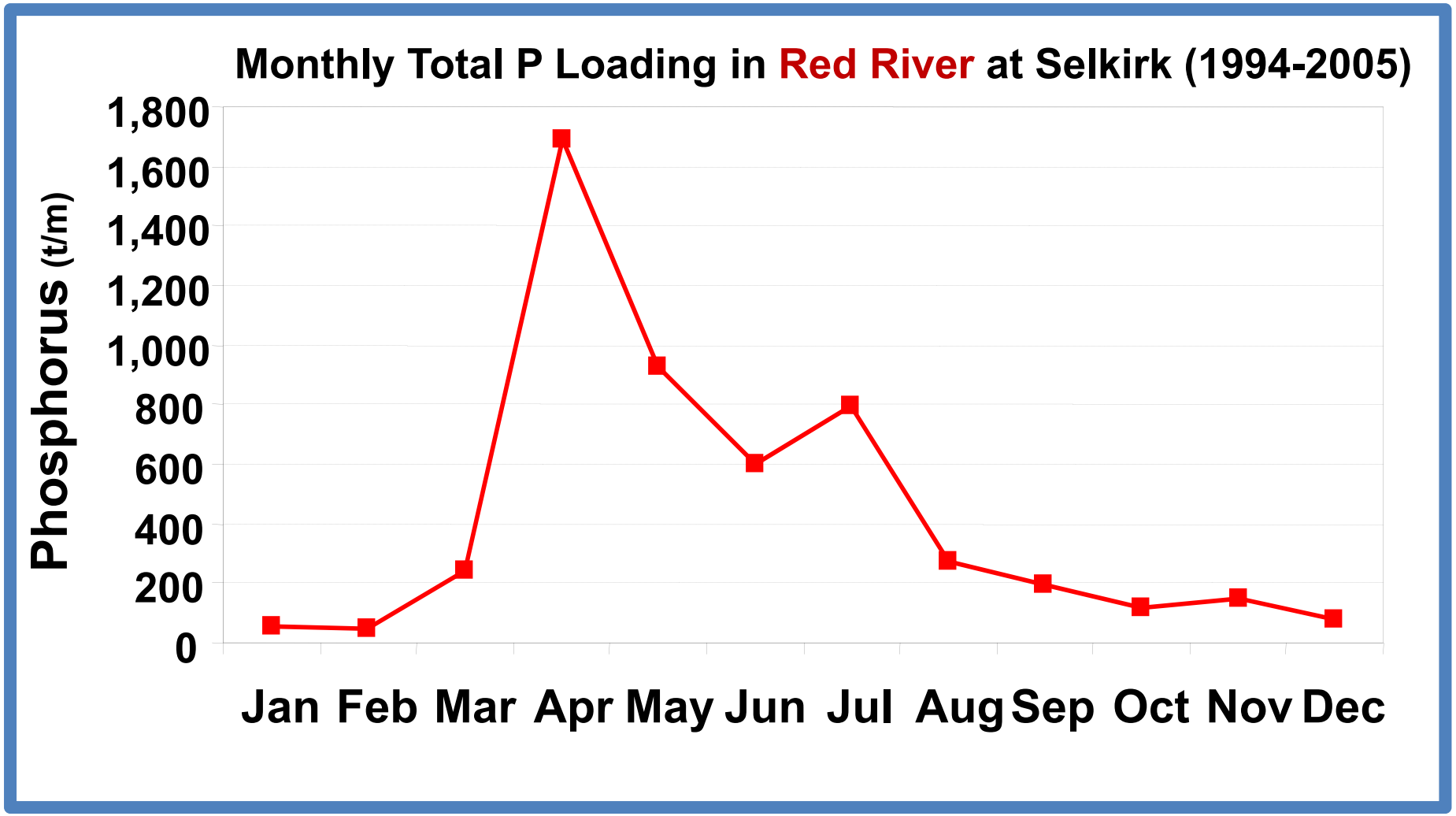

Daily Discharge for
RED RIVER AT EMERSON (05OC001)
2005 Data
Mean
Discharge (m^3/s)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Date

2009


Daily Discharge for
RED RIVER AT EMERSON (05OC001)
2009 Data
Mean
3000
2500
2000
1500
1000
500
0
Discharge (m^3/s)
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Date

Runoff and P transport

Most P loss on the Prairies occurs during snowmelt



Lake Winnipeg Stewardship Board Report, December 2006

When is winter?

Nutrient Application Dates

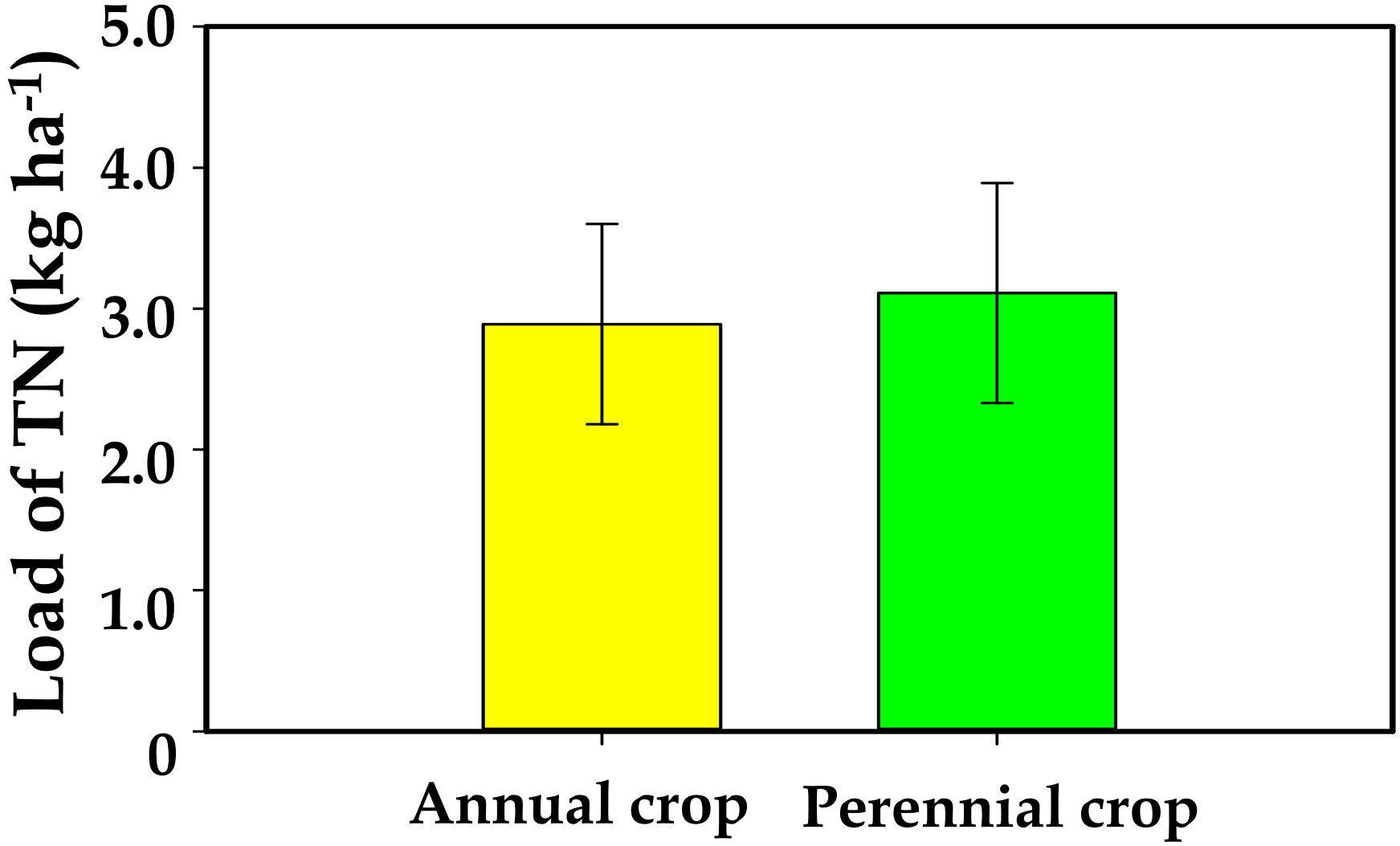
--- Not the Right Time…

"Winter" is the Wrong Time

Between November 10th of one year and April 10th of the following year, no substances containing N or P may be applied.

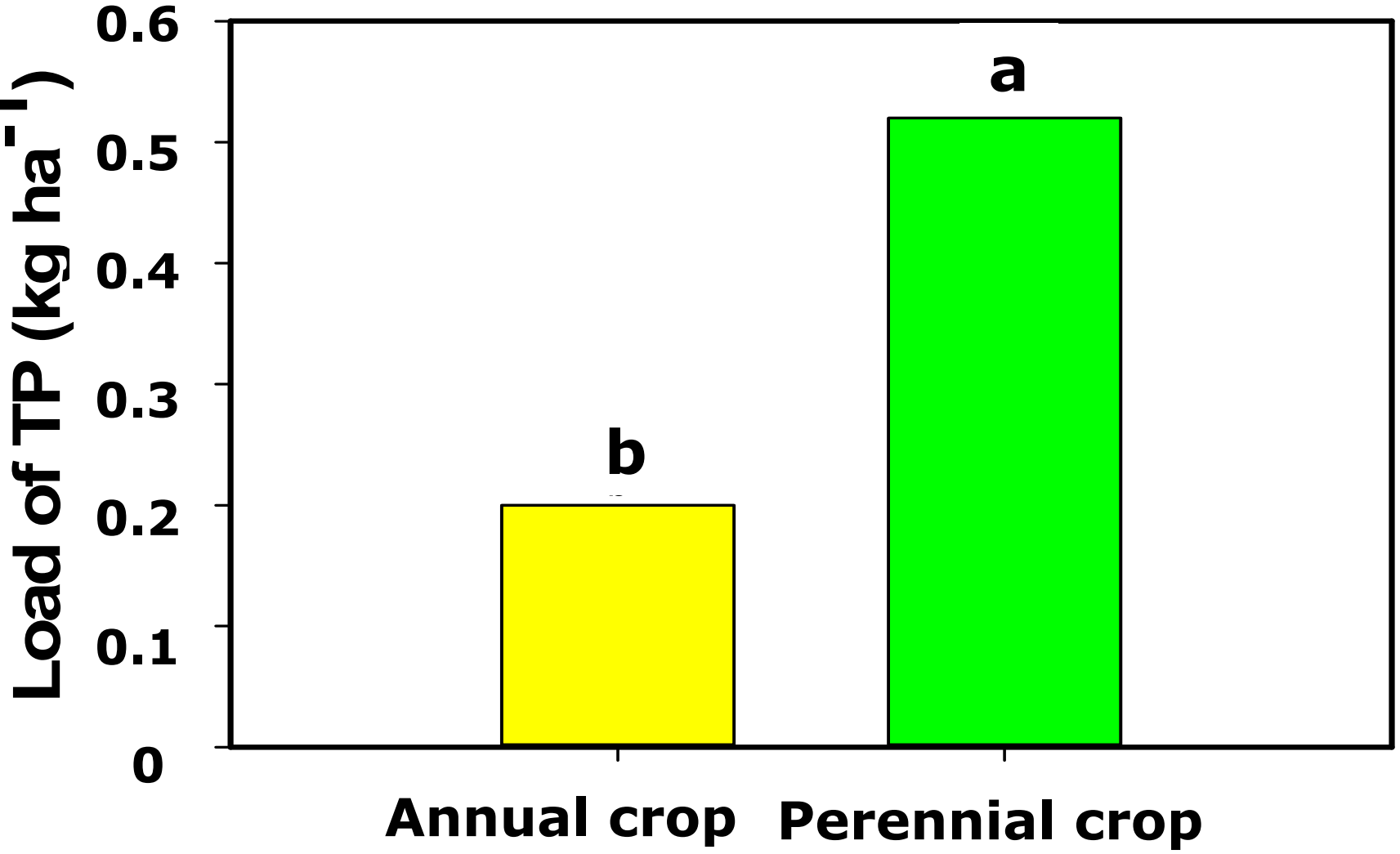
Note – - Dates may be varied.

WEBs* results for export of Total Nitrogen in runoff at Deerwood, MB



Watershed Evaluation of BMPs*: U of M, AAFC and Env' t Cda

WEBs results for export of Total Phosphorus in runoff at Deerwood, MB



Watershed Evaluation of BMPs*: U of M, AAFC and Env' t Cda

SURFACE WATER MANAGEMENT SOLUTIONS

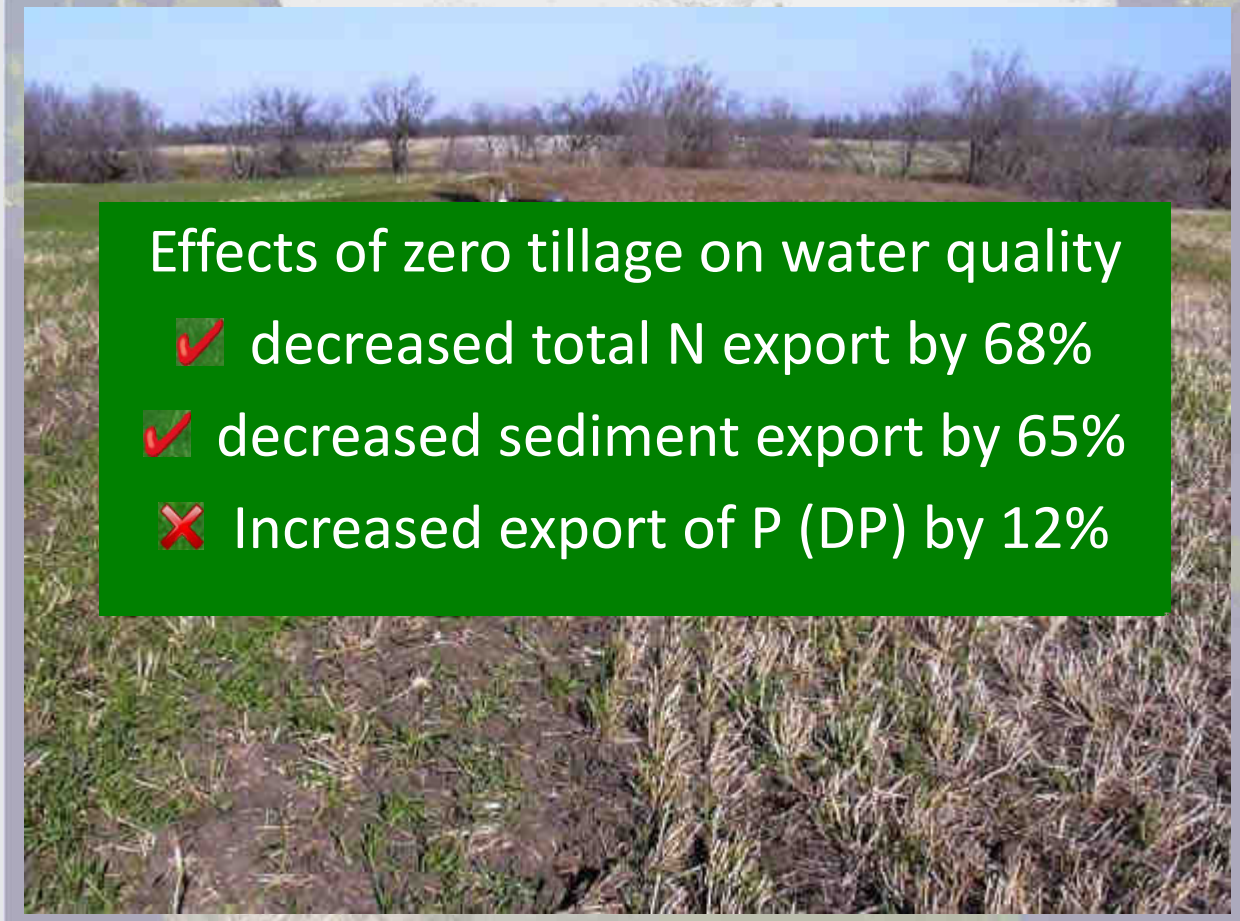
Conservation Tillage:

Conventional vs. conservation tillage in snowmelt dominated runoff:
South Tobacco Creek Watershed
WEBs Twin Watersheds Study

SURFACE WATER MANAGEMENT SOLUTIONS

Nothing is as simple as it seems

Conservation Tillage



Effects of zero tillage on water quality

- ✔ decreased total N export by 68%
- ✔ decreased sediment export by 65%
- ✘ Increased export of P (DP) by 12%

Conclusion

– manage the runoff and the vegetation

SURFACE WATER MANAGEMENT SOLUTIONS

Nothing is as simple as it seems

Riparian Buffers:

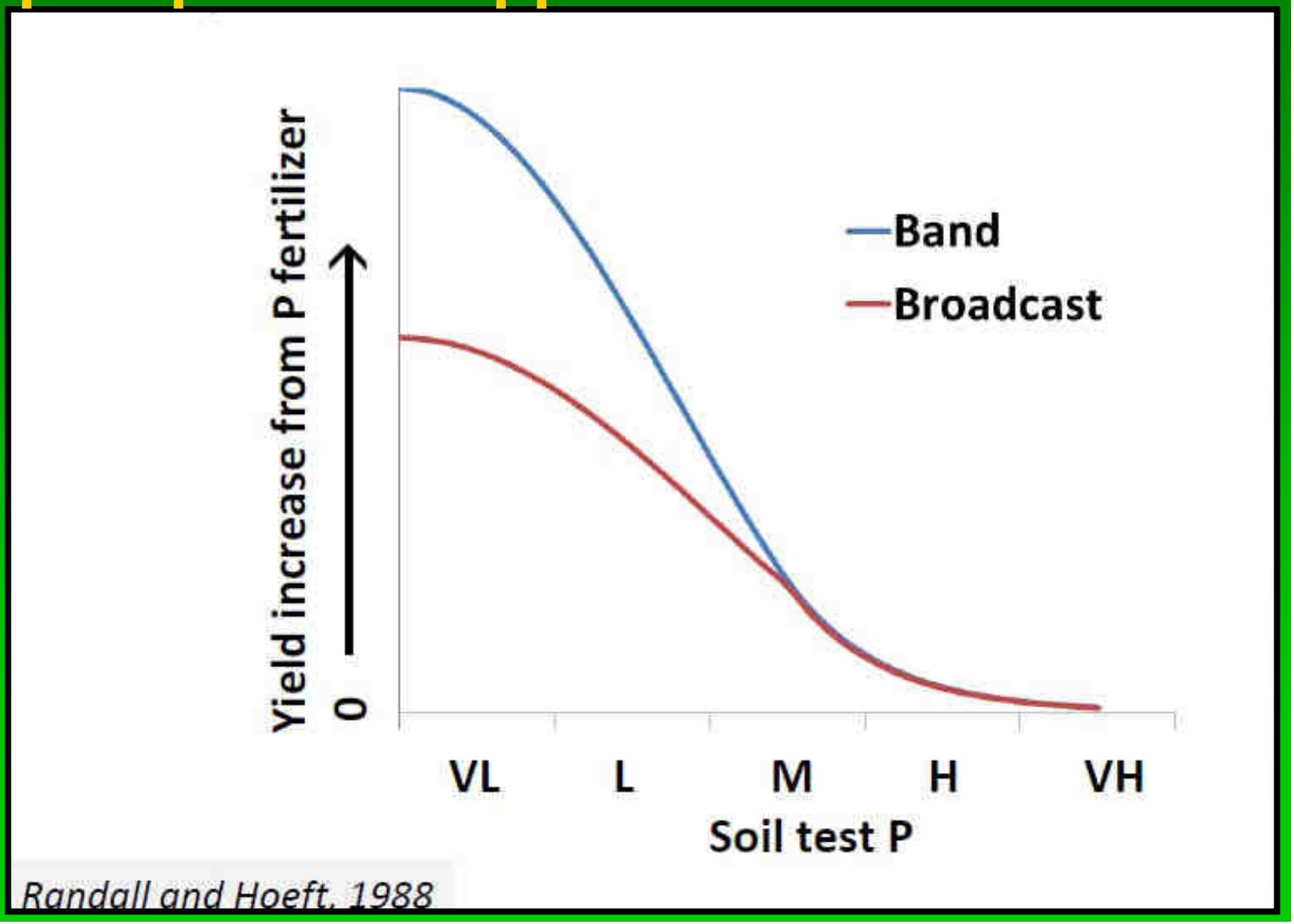
Riparian areas are not effective in filtering sediments and nutrients in runoff from land

Conclusion – manage the vegetation and runoff

RIGHT ***PLACE***

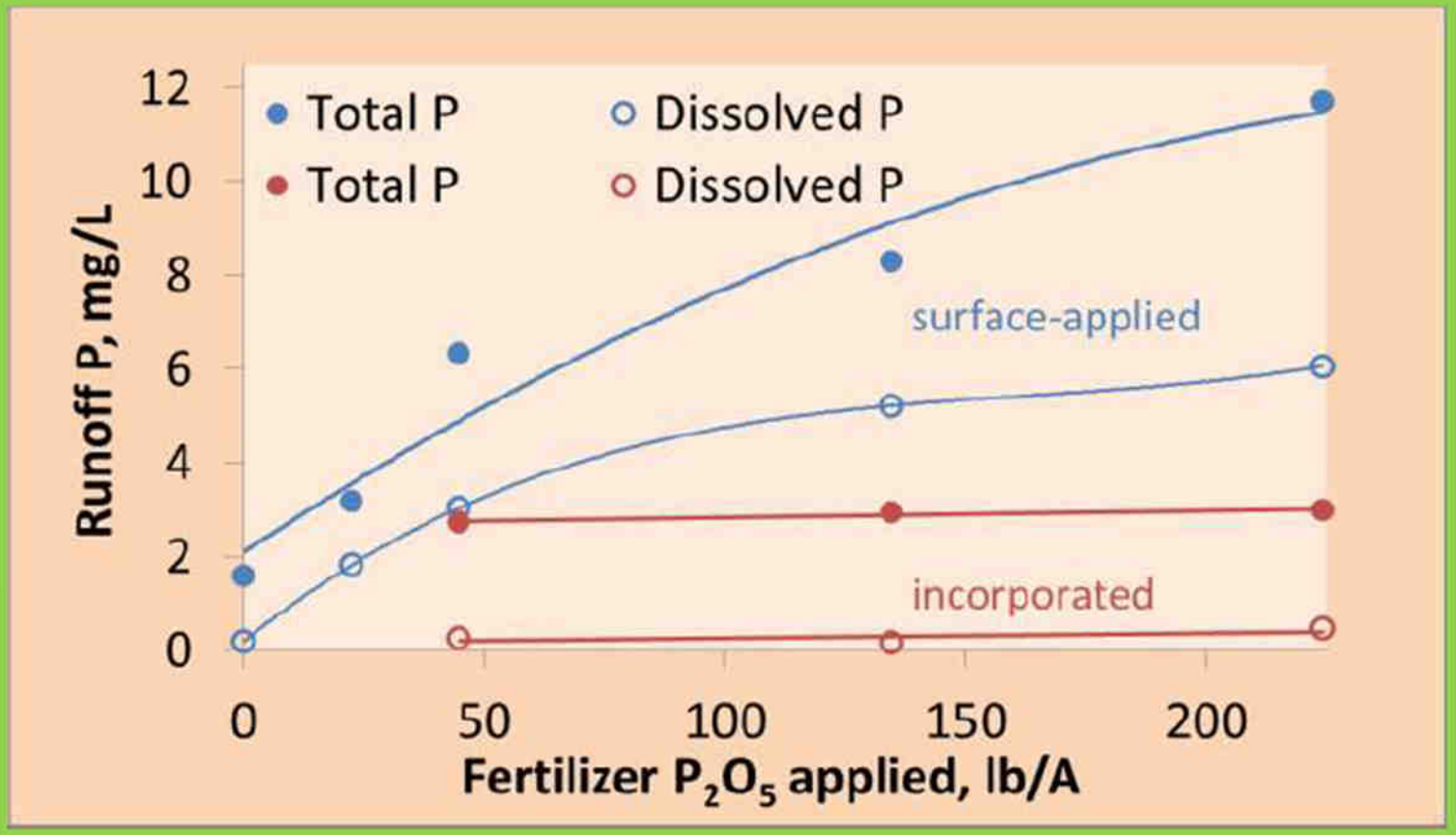
Idealized effect of placement on crop response to applied P

Slide from Dr. T. Bruulsema, IPNI



Randall and Hoeft, 1988

Placing P in the soil reduces P loss from a single immediate runoff event

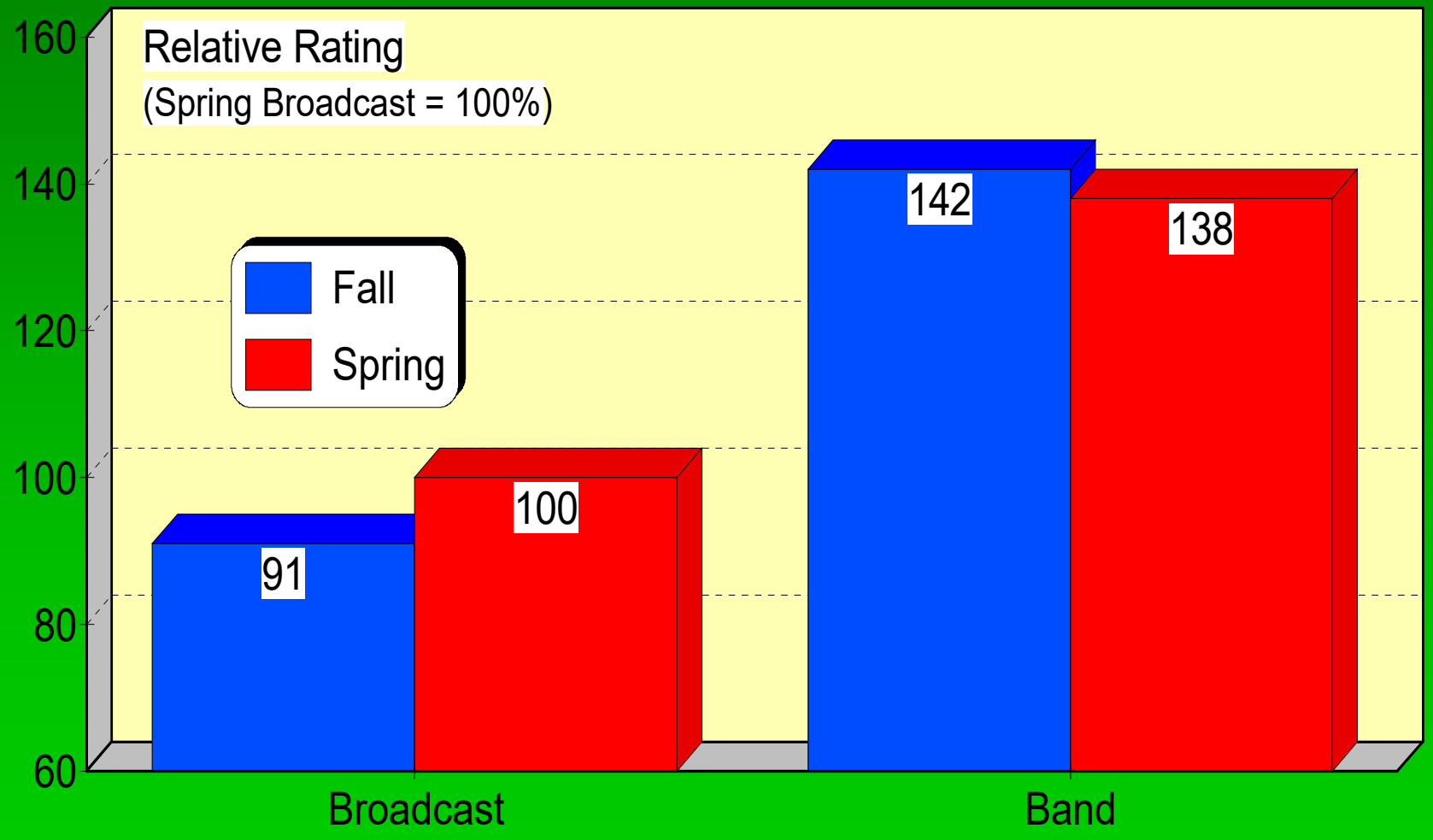


Concentration of dissolved and total P in runoff from a clay loam soil in North Carolina, from artificial rainfall immediately following application of superphosphate fertilizer. Incorporation was to a depth of 5 inches by rotary tillage following application. Data from Tarkalson and Mikkelson (2004).

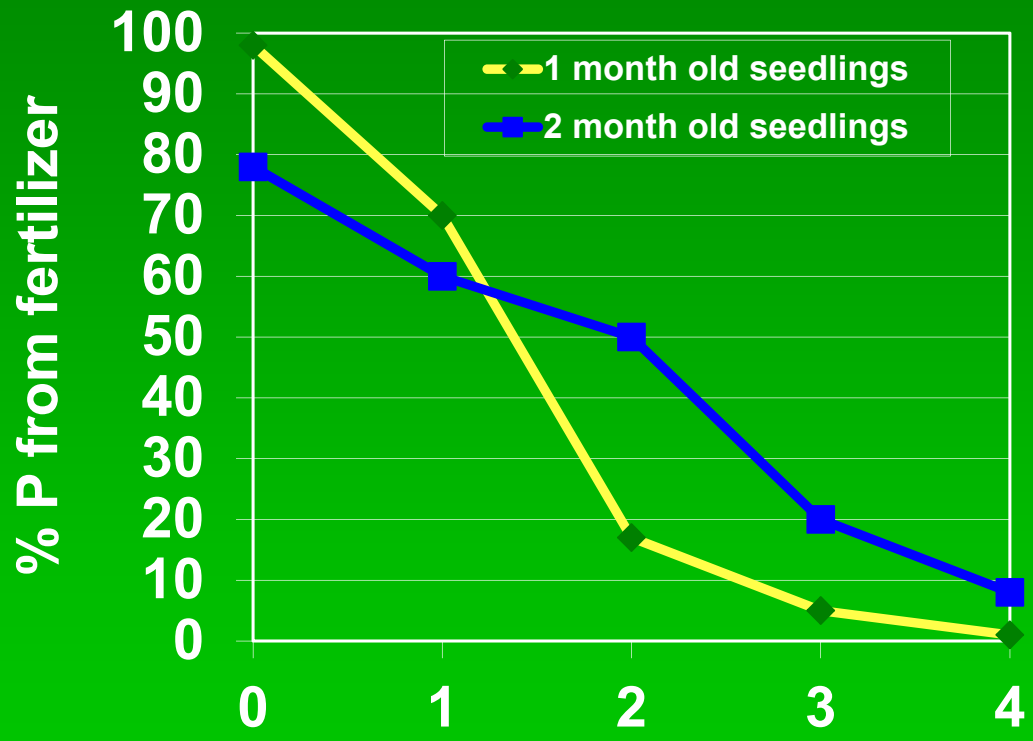
Slide from Dr. T. Bruulsema, IPNI

IPNI

Rating Nitrogen Application Options



Alfalfa benefits from banding directly over P fertilizer

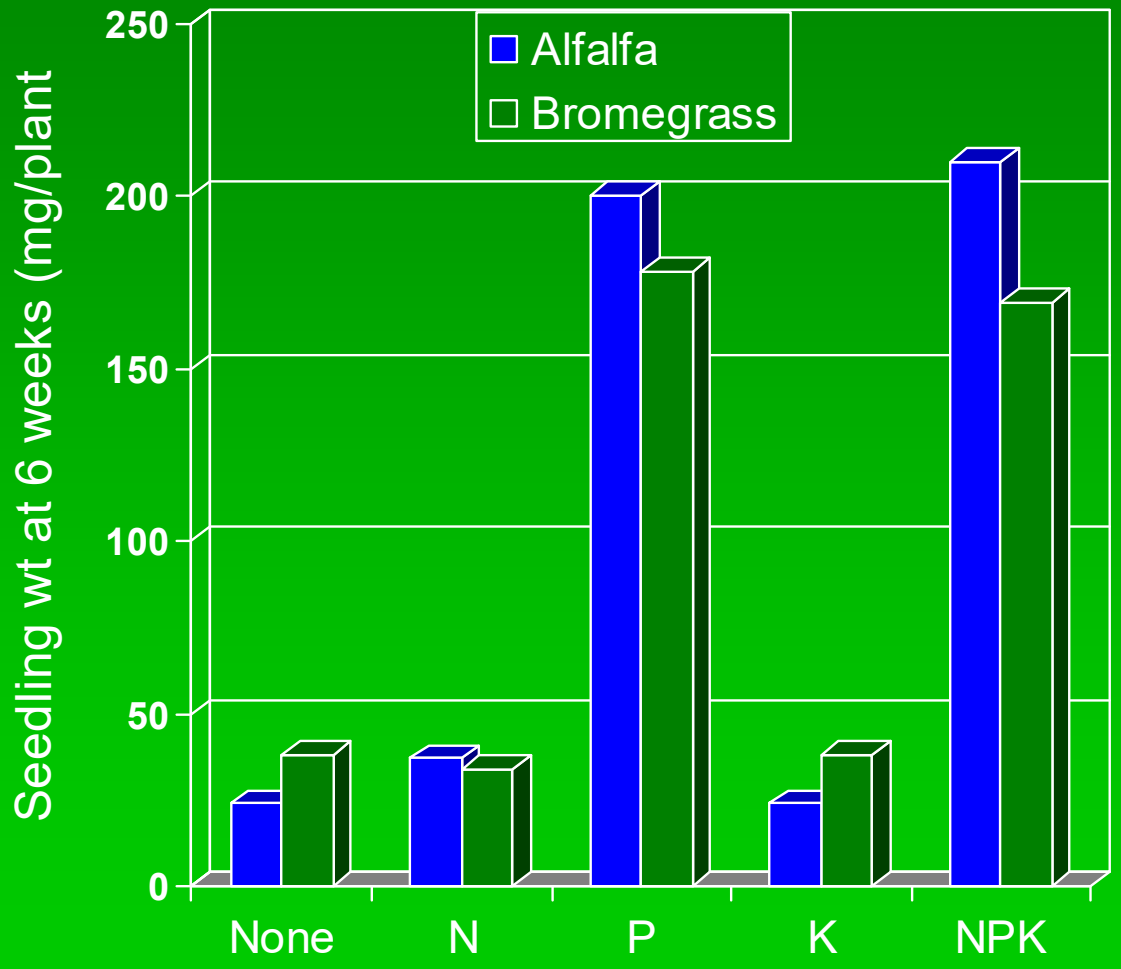


Banded P Broadcast P

(Heard, OMAFRA)

Tesar, Michigan, 1984

Influence of Nitrogen, Phosphorus and Potassium on Seedling Vigour



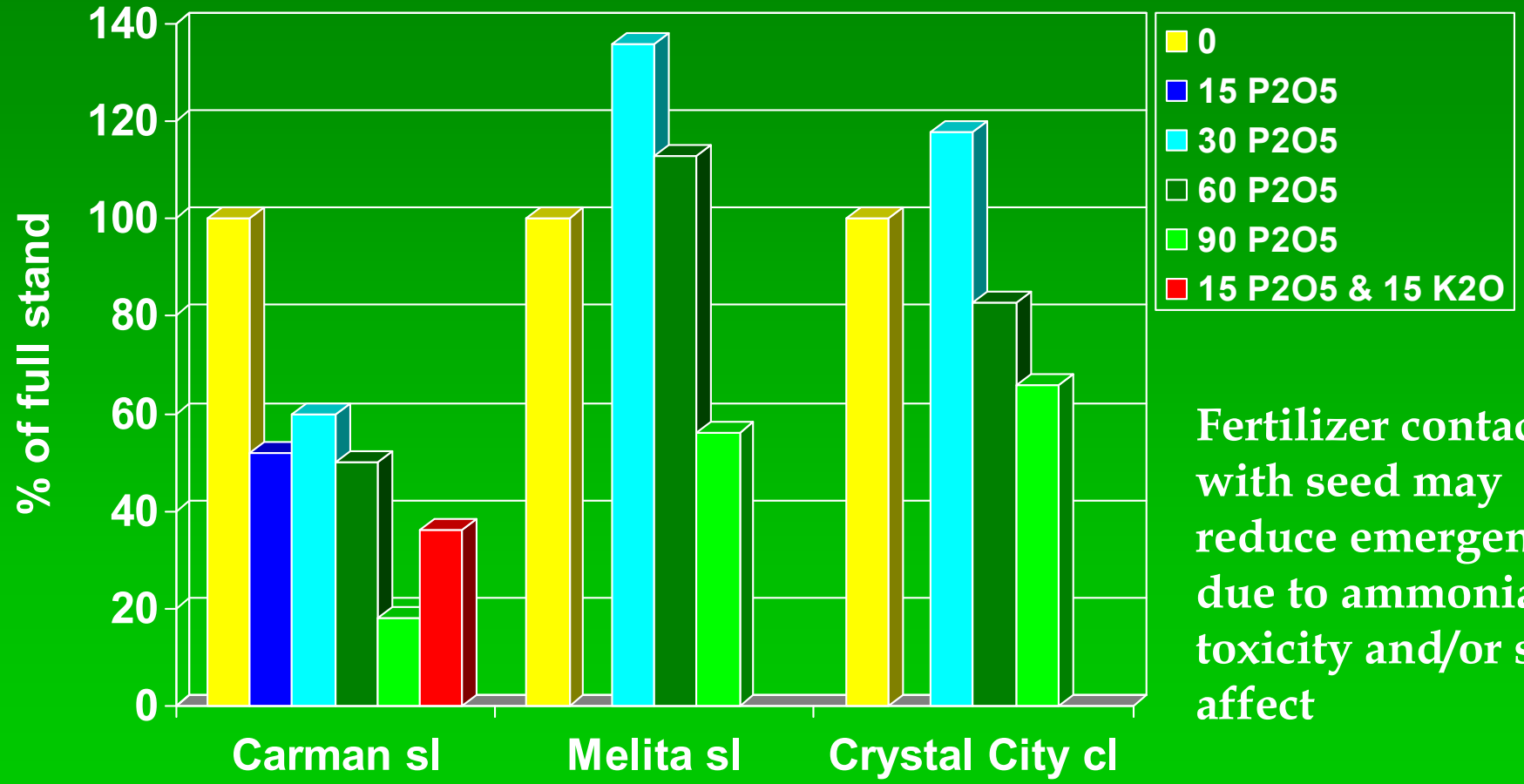
100 lb/ac nutrient applied
Sheard, U of Guelph, Ontario

Research from as early as 1950 in Ohio showed P banded 1-2" below the seed improved growth and establishment of forages

MAFRI guide:

- 55-75 lb P_2O_5/ac for legumes
- 30-40 lb P_2O_5/ac for grasses

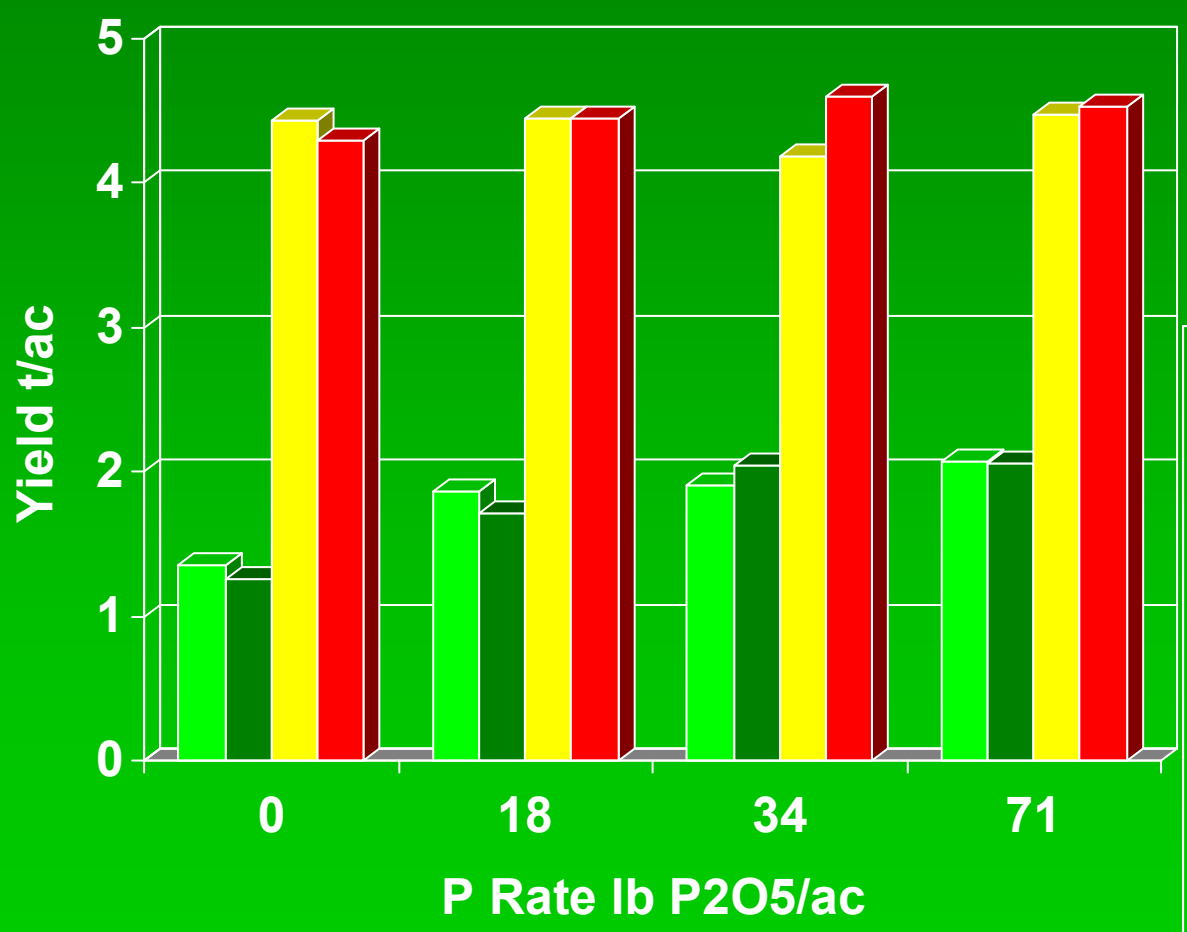
Effect of seed-placed MAP (11-52-0) on alfalfa establishment



Fertilizer contact with seed may reduce emergence due to ammonia toxicity and/or salt affect

Heard, 2001 Crop Diagnostic School demonstrations

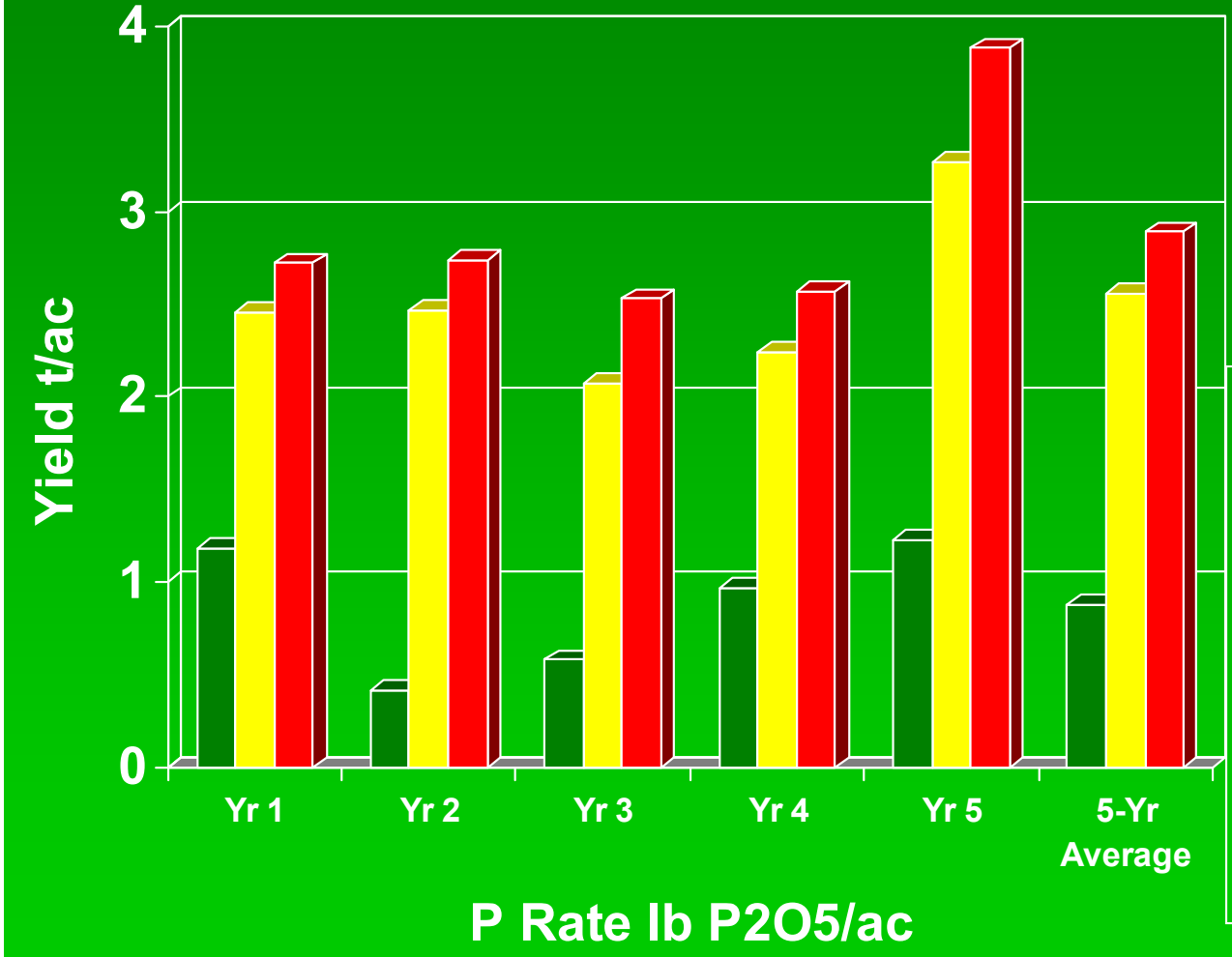
Band Injection of P into Alfalfa



- banded dry fertilizer 1-2″ deep into alfalfa with double disk drill
- some alfalfa injury from banding on sand
- P increased yield by 47% on clay, little on sand
- no advantage to banding K

Simons, Grant and Bailey - AAFC-Brandon

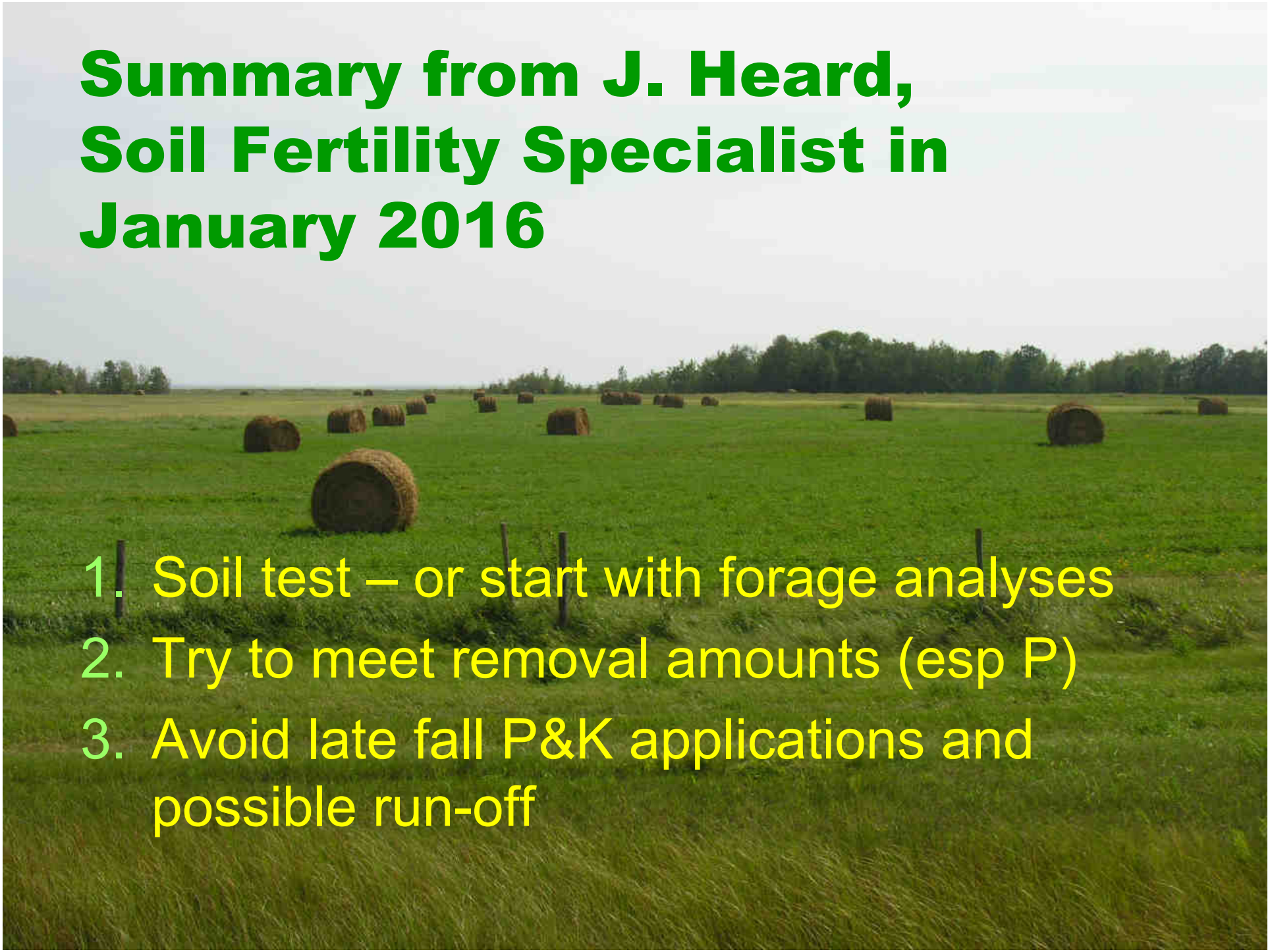
Band Injection of P into Alfalfa



- Banded 2″ deep with coulter-type disc opener (6″ spacing) in mid to late April
- average of 20-80 lb P_2O_5/ac rates as 0-46-0

Malhi - Alberta (1999)

Summary from J. Heard, Soil Fertility Specialist in January 2016



1. Soil test – or start with forage analyses
2. Try to meet removal amounts (esp P)
3. Avoid late fall P&K applications and possible run-off

Taking it home...

- To fully exploit the potential that forages and grasslands have to offer (and not squander a glorious opportunity):
  - Right Source – consider all options: commercial fertilizer, manure, legumes...
  - Right Rate – if national, regional and local production objectives are to be met...
  - Right Time – follow the law because it just makes sense on so many levels...
  - Right Place – efficiency is all the more critical if returns on investment are, well...


Grab your opportunity
when it arrives!