

4R N Management for Corn

AGVISE Soil Fertility Seminar

March 14, 2018 Portage

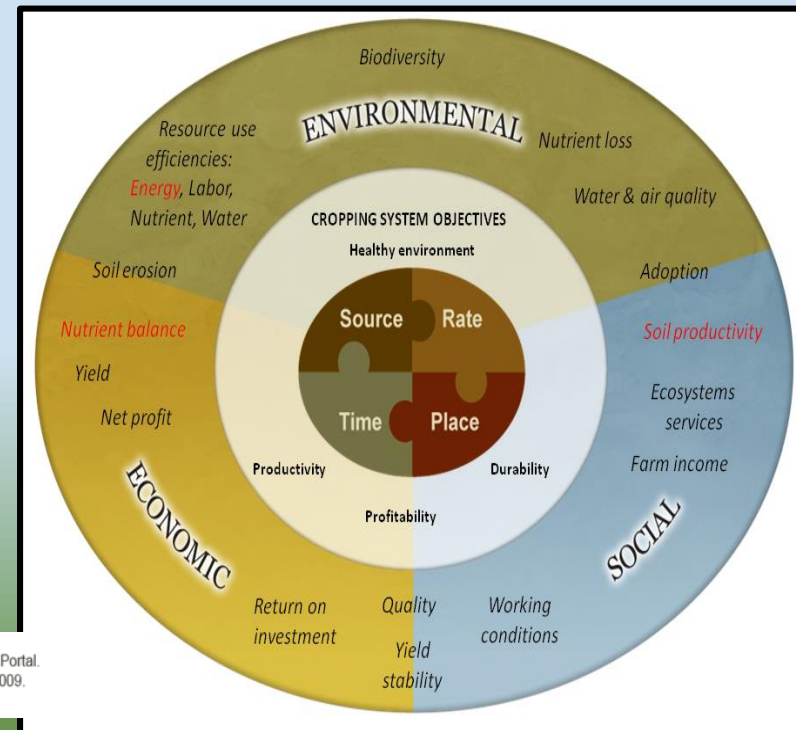
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Topics



- 1) Overview of corn in Manitoba
- 2) Current recommendations
- 3) Decision tools
- 4) Research questions
- 5) Research project



Corn Production in MB is Increasing

- **By Acres**
 - **85 000 grain acres in 1990**
 - **185 000 grain acres in 2010**
 - **395 500 grain acres in 2017**
- **By Yield**
 - **With better, earlier maturing hybrids, plus longer growing season**
 - **76.5 bu/acre provincial average 1990**
 - **105 bu/acre provincial average 2010**
 - **134 bu/ acre provincial average 2017**

Research Justification

Recommendation is outdated:

- much higher yields
- hybrids have improved N use efficiency (require less N/bu)
- Popularity of enhanced efficiency fertilizers (EEF)

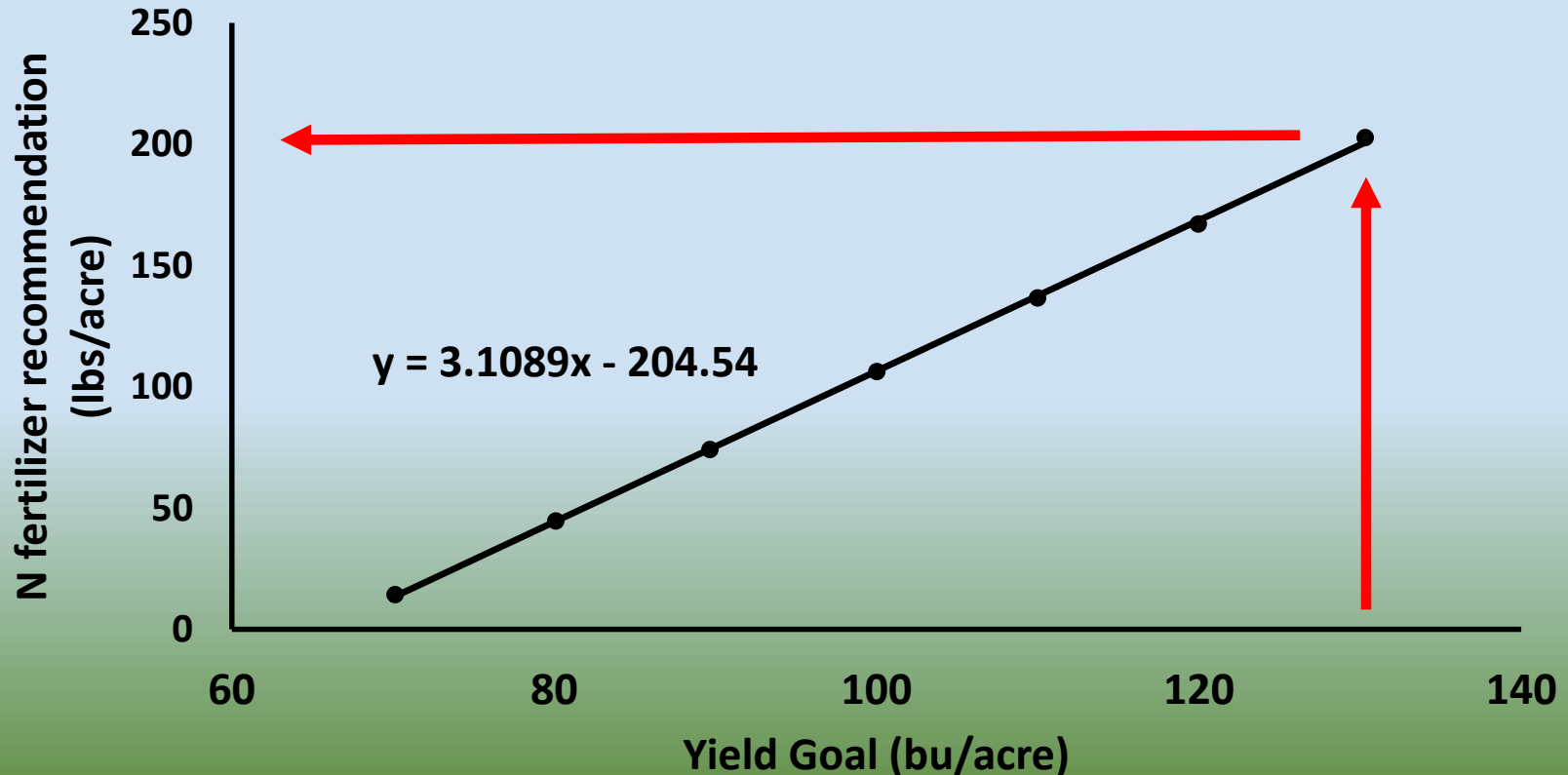
More and more important to apply the proper rate

- cost of fertilizer increasing
- environmental concerns

Research Justification

Last work at U of M done in 1981-83

- Linear relationship for N recommendation on basis of target yield using lbs N/bushel
- 200 lbs N fertilizer recommended with 35 lb soil test N for 130 bu/ac yield goal
- 1.8 lbs total N/bu



Variable Recommendations

Guide to Corn Production in Manitoba (2004)

- Maximum target yield of 130 bu/ac, where 225 lbs N/ac recommended with 30 lbs soil test N
- Total of 255 lbs soil test plus fertilizer N/ac
- 2.0 lbs total N/bu

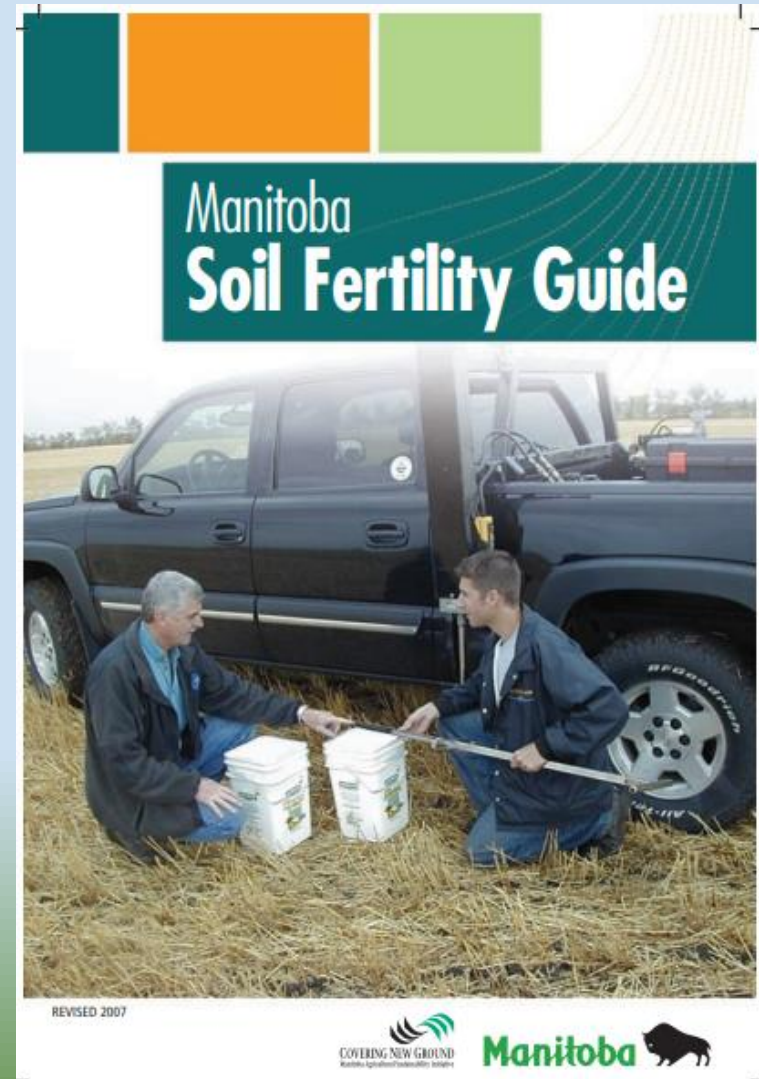
TABLE 5: Nitrogen recommendations for corn (based on a spring banded application)

Target Yield		Nitrogen Recommendation (lb/ac)			
Grain Yield bu/ac		130	115	100	85
Silage Yield t/ac @ 70% moisture		19.4	17.1	14.9	12.6
Fall Soil NO ₃ -N (lb/ac in 0-24 in)	Rating				
20	VL	260	205	150	95
30	L	225	170	115	60
40	M	200	145	90	35
50	M	170	115	60	5
60	H	140	85	30	0
70	H	110	55	0	0
80	VH	80	25	0	0
90	VH	55	0	0	0
100	VH+	25	0	0	0

Variable Recommendations

Manitoba Soil Fertility Guide (2007)

- Maximum target yield of 130 bu/ac
- 195 lbs of fertilizer N recommended with 30 lbs soil test N
- 1.7 lbs total N/bu



Variable Recommendations

AGVISE Labs

- for target yield of 130 bu/ac and 30 lbs residual N, apply 127 lbs fertilizer N
- 1.2 lbs N / bushel

CORN - GRAIN

25

YIELD NITROGEN

SOIL PHOSPHORUS (ppm)

SOIL POTASSIUM (ppm)


Bushels /Acre	Soil + Fertilizer	0-3 0-5	4-7 6-10	8-11 11-15	12-15 16-20	16-19 20-25	20-40 26-33	41-75 54-100	76+ 101+ BRAY	0-40	41-80	81-120	121-160	161-200	201-250	251-750	750+
AGVISE BAND																	
100	120	50	40	30	20	15*	15*	15*	0	65	50	35	20	10*	10*	10*	0
120	145	60	50	35	25	15*	15*	15*	0	75	60	45	25	10*	10*	10*	0
140	170	70	60	45	30	15*	15*	15*	0	90	70	50	30	10	10*	10*	0
160	190	85	65	50	35	15*	15*	15*	0	100	80	55	35	15	10*	10*	0
180	215	95	75	55	35	20	15*	15*	0	115	90	65	40	15	10*	10*	0
200	240	105	85	60	40	20	15*	15*	0	125	100	70	45	15	10*	10*	0
220	265	115	90	70	45	25	15*	15*	0	140	110	80	50	20	10*	10*	0
240	290	125	100	75	50	25	15*	15*	0	150	120	85	55	20	10*	10*	0
Minimum Nitrogen = 10										* Starter							
AGVISE BROADCAST																	
100	120	90	75	60	45	30	15*	15*	0	120	95	70	40	15	10*	10*	0
120	145	105	90	70	55	40	15*	15*	0	145	110	80	50	20	10*	10*	0
140	170	125	105	85	65	45	15*	15*	0	165	130	95	60	25	10*	10*	0
160	190	145	120	95	75	50	15*	15*	0	190	150	110	65	25	10*	10*	0
180	215	160	135	110	85	55	15*	15*	0	215	170	120	75	30	10*	10*	0
200	240	180	150	120	90	65	15*	15*	0	240	185	135	85	35	10*	10*	0
220	265	195	165	135	100	70	15*	15*	0	260	205	150	95	35	10*	10*	0
240	290	215	180	145	110	75	15*	15*	0	285	225	165	100	40	10*	10*	0
Minimum Nitrogen = 10																	
AGVISE BROADCAST WITH SOIL MAINTENANCE																	
100	120	90	75	60	45	40	40	15*	0	120	95	70	40	25	25	10*	0
120	145	105	90	70	55	50	50	15*	0	145	110	80	50	30	30	10*	0
140	170	125	105	85	65	55	55	15*	0	165	130	95	60	35	35	10*	0
160	190	145	120	95	75	65	65	15*	0	190	150	110	65	45	45	10*	0
180	215	160	135	110	85	70	70	15*	0	215	170	120	75	50	50	10*	0
200	240	180	150	120	90	80	80	15*	0	240	185	135	85	55	55	10*	0
220	265	195	165	135	100	90	90	15*	0	260	205	150	95	60	60	10*	0
240	290	215	180	145	110	95	95	15*	0	285	225	165	100	65	65	10*	0
Minimum Nitrogen = 10																	
AGVISE BAND WITH SOIL MAINTENANCE																	
100	120	50	40	40	40	40	40	15*	0	65	50	35	25	25	25	10*	0
120	145	60	50	50	50	50	50	15*	0	75	60	45	30	30	30	10*	0
140	170	70	60	55	55	55	55	15*	0	90	70	50	35	35	35	10*	0
160	190	85	65	65	65	65	65	15*	0	100	80	55	45	45	45	10*	0
180	215	95	75	70	70	70	70	15*	0	115	90	65	50	50	50	10*	0
200	240	105	85	80	80	80	80	15*	0	125	100	70	55	55	55	10*	0
220	265	115	90	90	90	90	90	15*	0	140	110	80	60	60	60	10*	0
240	290	125	100	95	95	95	95	15*	0	150	120	85	65	65	65	10*	0
Minimum Nitrogen = 10																	
UNIVERSITY BROADCAST																	
100	120	60	45	25	15*	15*	15*	15*	0	100	75	45	15	10*	10*	10*	0
120	145	75	60	30	15*	15*	15*	15*	0	120	85	50	15	10*	10*	10*	0
140	170	85	60	35	15*	15*	15*	15*	0	145	100	60	20	10*	10*	10*	0
160	190	100	70	40	15*	15*	15*	15*	0	165	115	70	25	10*	10*	10*	0
180	215	110	80	45	15*	15*	15*	15*	0	185	130	80	25	10*	10*	10*	0
200	240	120	85	50	15*	15*	15*	15*	0	205	145	85	30	10*	10*	10*	0
220	265	135	95	55	20	15*	15*	15*	0	225	160	95	30	10*	10*	10*	0
240	290	145	105	60	20	15*	15*	15*	0	245	175	105	35	10*	10*	10*	0

Variable Recommendations

NDSU

- For 130 bu/ac yield goal in zone for <160 bu/ac avg
- 120 lbs fertilizer N recommended with 30 residual
- 1.2 lbs total N/bu

North Dakota Corn Nitrogen Calculator



Region:
West River: ☐
Eastern ND: ☒

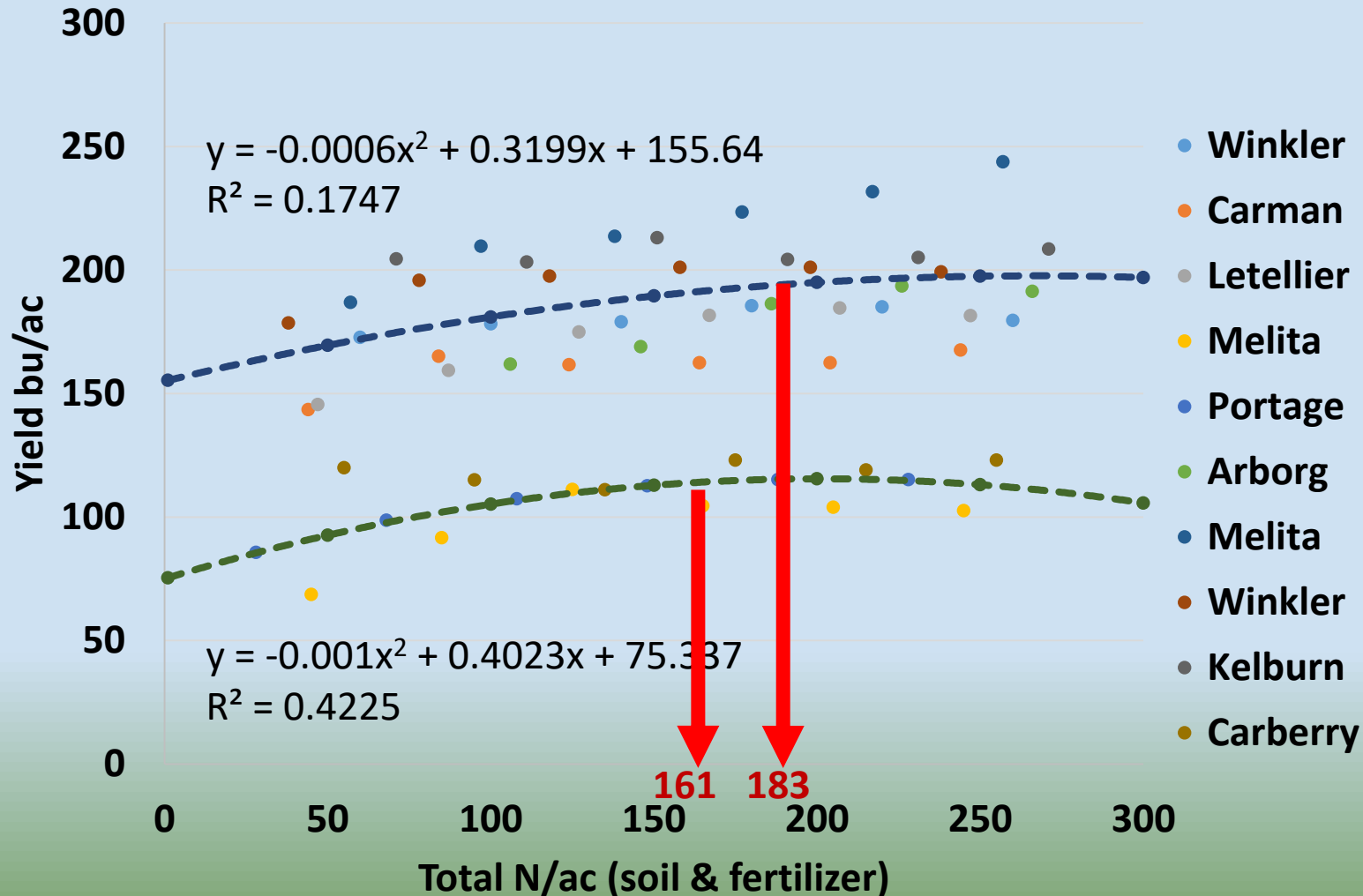
Field Information (If in Eastern ND):
☐ No-Till for 6+ Years
☐ Irrigated Corn
☒ Conventional Till/Minimal No-Till
☐ Conventionally-Tilled
☐ No-Till for 1-5 years
☒ High-Clay Soils
☐ Historic Yield > 160 bu/a
☐ Historic Yield less than 160 bu/a
☐ Medium-Texture Soils
☐ Historic Yield > 160 bu/a
☐ Historic Yield less than 160 bu/a

Input Nearest Corn Price (\$/Bushel):
Input Nearest Nitrogen Cost (\$/Pound):
Soil Test for Nitrogen Analysis (lbs/acre 2-ft depth):
Percent Organic Matter In Soil:

Previous Crops Planted:
Nitrogen Recommendation:
plus/minus 30 lbs.

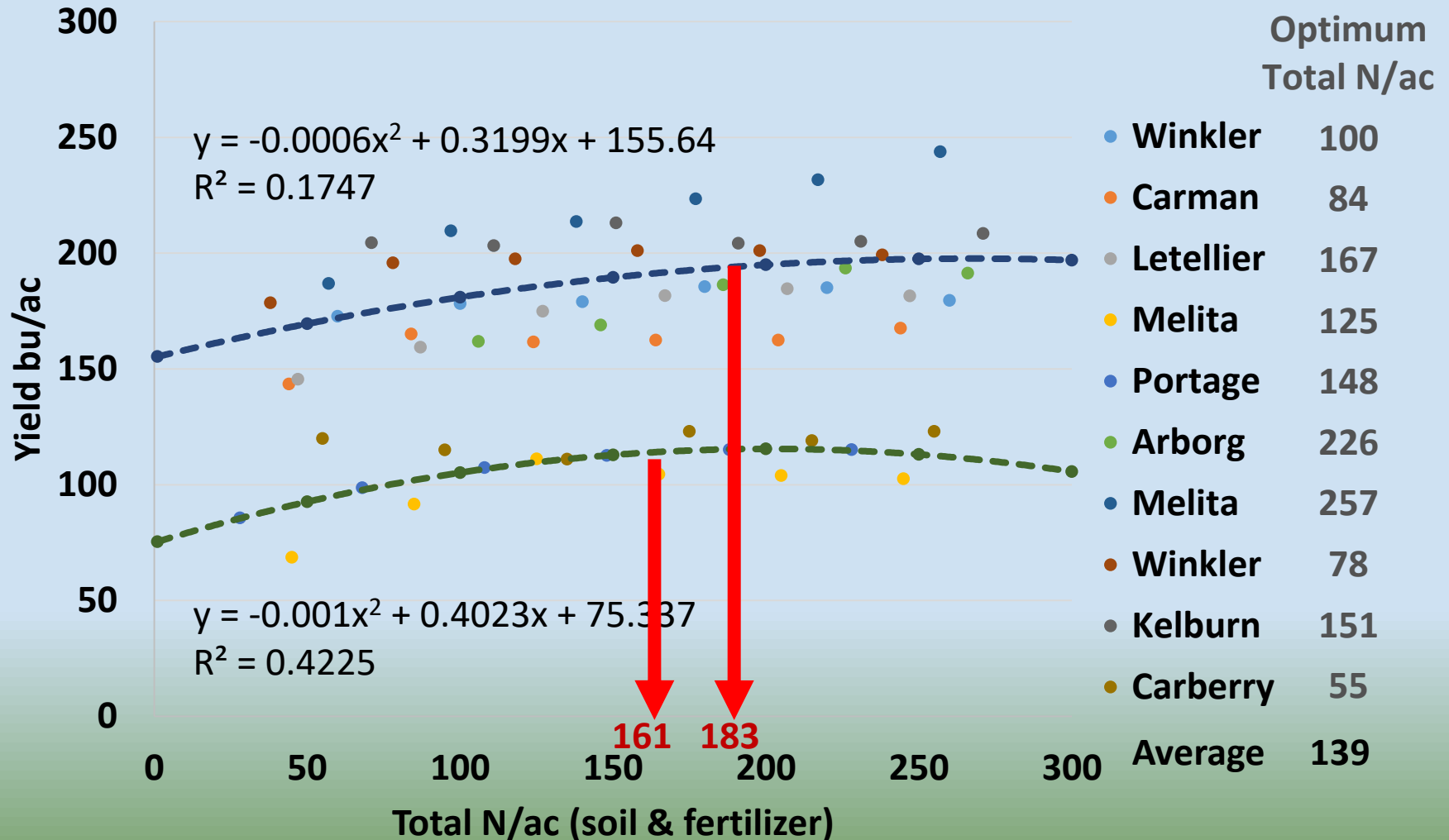
John Heard (MB Ag) Pilot Study

MERN@ \$4/bu corn and \$0.40/lb N



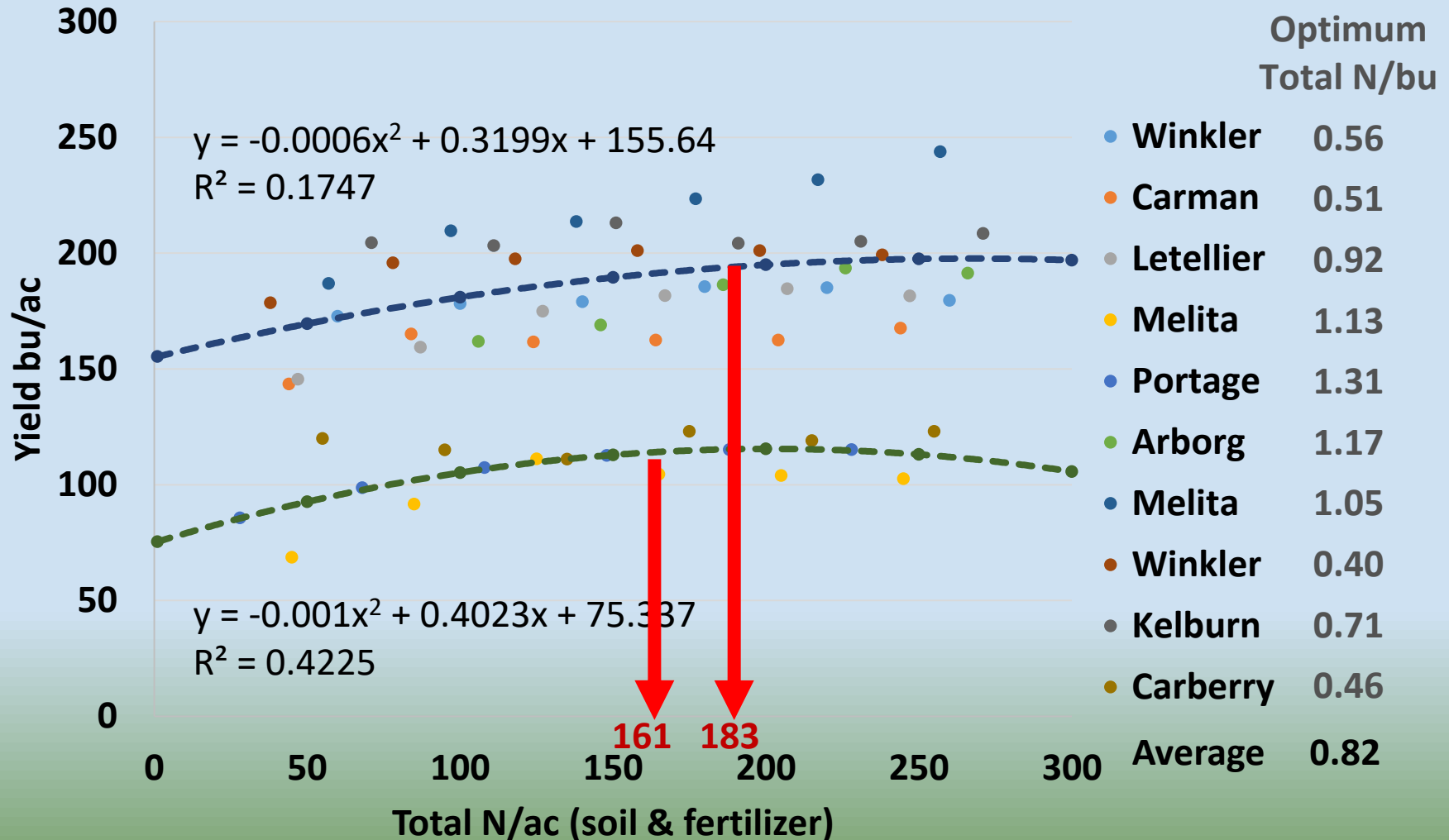
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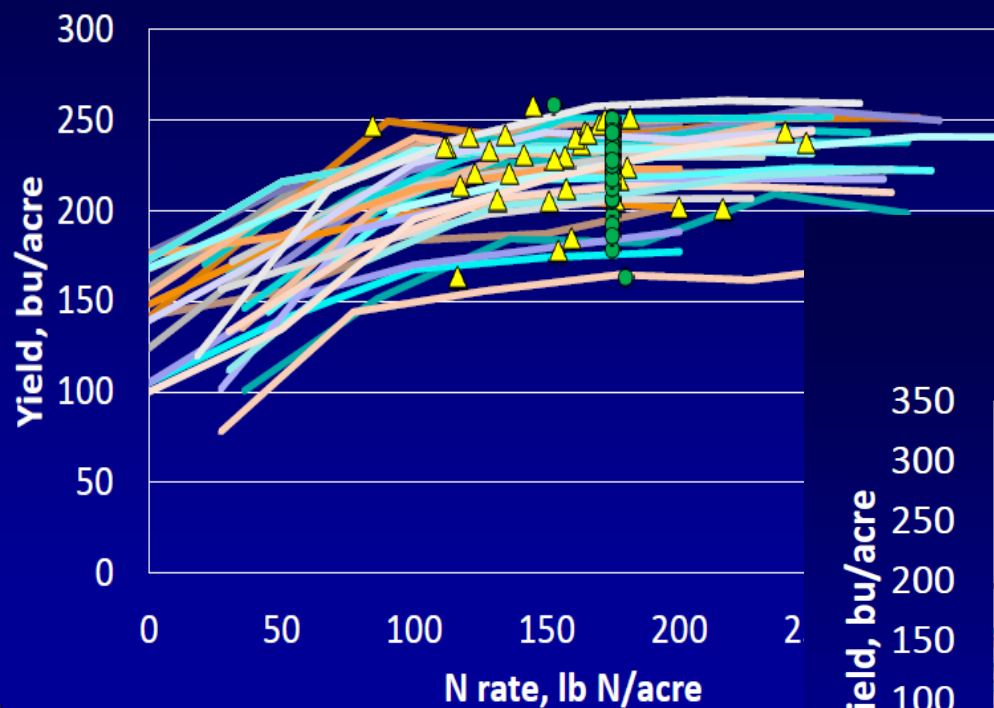


University of Illinois

Dr. Emerson Nafziger

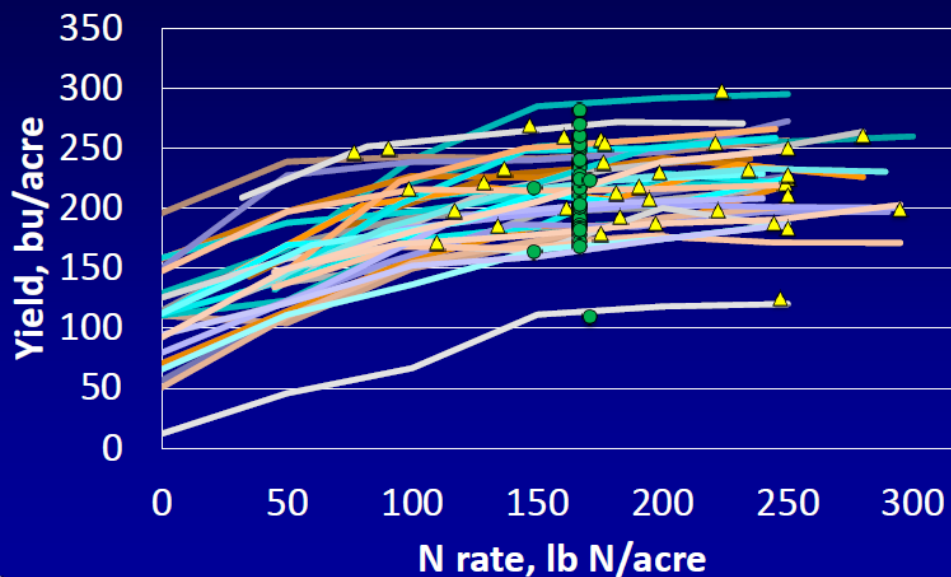
33 on-farm N trials Soy-Corn 2016

▲ Optimum ● MRTN



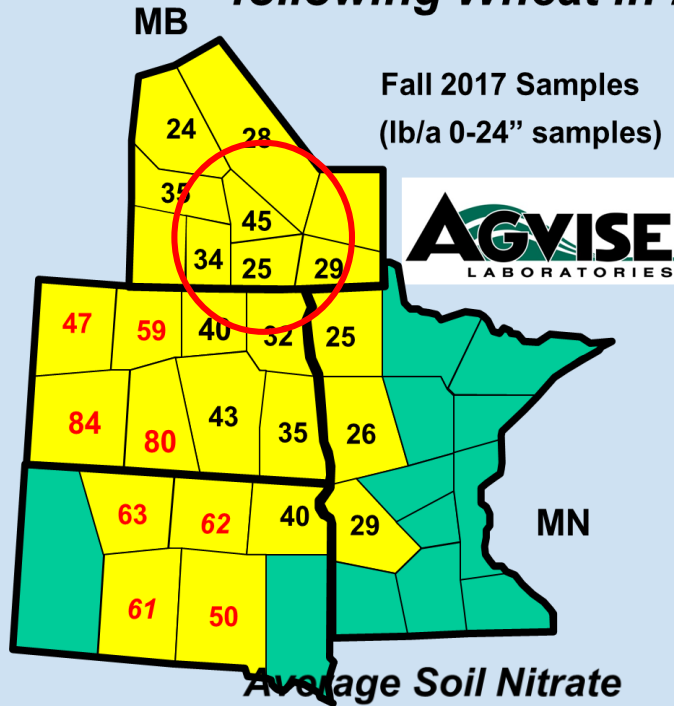
35 on-farm trials Soy-Corn 2015

▲ Optima ● MRTN

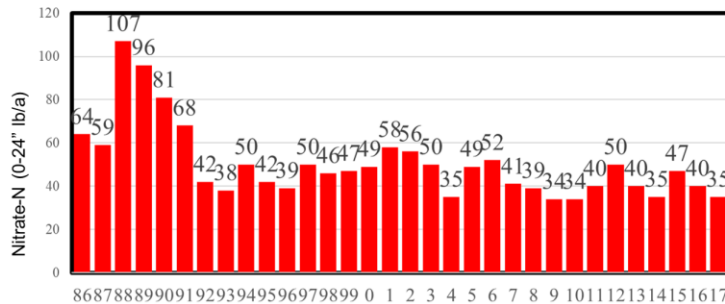


Evidence of excessive corn N rates

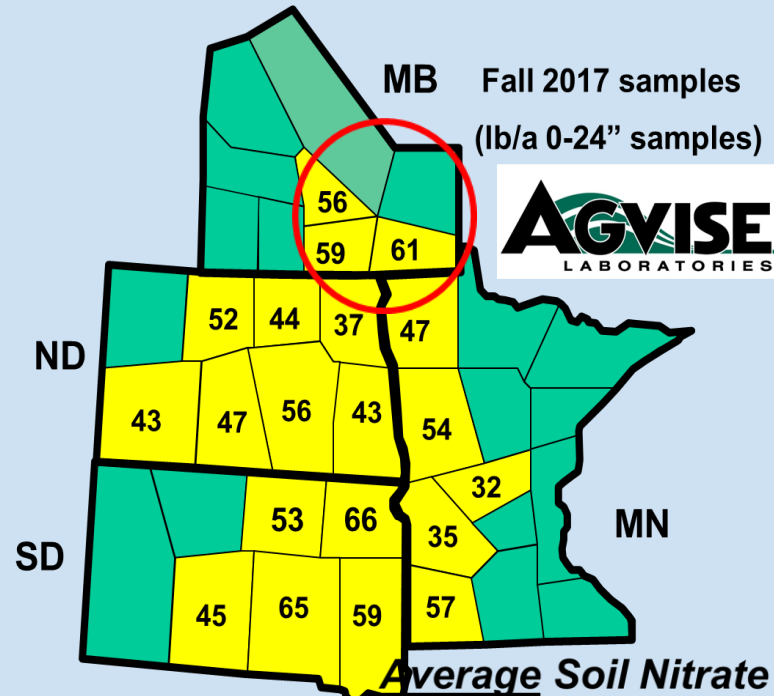
Median Soil Nitrate following Wheat in 2017



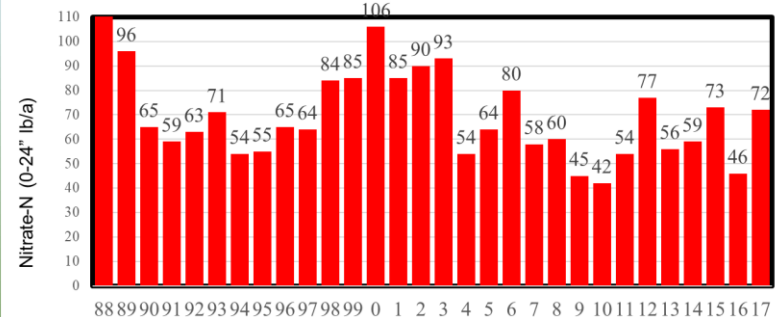
Average Soil Nitrate Following "Wheat" in Canada 1986 - 2017



Median Soil Nitrate following Corn in 2017



Average Soil Nitrate Following "Corn" in Canada 1988 - 2017



Several methods for determining N fertilizer recommendations

Soil Testing

- Pre-plant nitrate test
- Side dress nitrate test
- Use a yield goal and determine the rate

Canopy Sensing

- Many instruments using red and near-infrared wavelength's to measure the canopy chlorophyll content, and quantify the nitrogen status of the plant.
- hand held, mounted on equipment, or flown

Empirical Models

- Using past database to predict crops nitrogen demand
- Many factors considered, but not field specific
- MERN – Maximum Economic Return to Nitrogen based on an equation ... eg. a quadratic equation for N response

Optimum Nitrogen Fertilizer Management Strategies for Modern Corn Hybrids in Manitoba

- **Lanny Gardiner & Don Flaten (Dept of Soil Science) and John Heard (Mb Ag)**
- **8 sites planned for each year (2017 and 2018)**



Research Questions

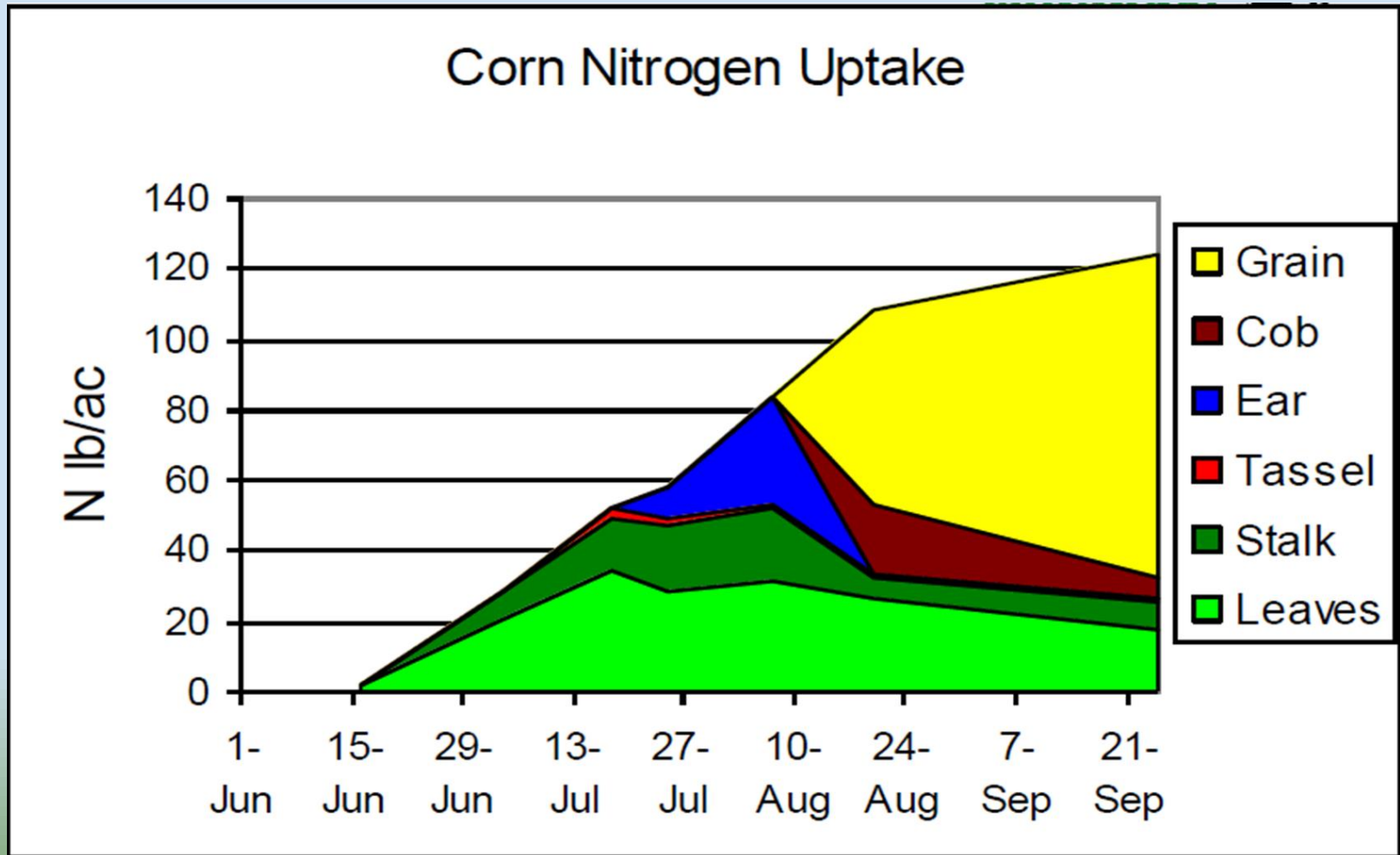
How useful and to what potential can inhibitors or EEF be used?

Can split application increase yield and/ or reduce N fertilizer applied in some years?

All sources can be equal, determine individual timing and placement to make this true

What are the most reliable in season signs of plant and soil nitrogen status?

Matching N supply with plant demand



Corn Production in Manitoba, Soil, Nutrition and Fertilizers (2004)

Improve upon matching N supply with plant demand

- **More precise N rate (lbs/acre & lbs/ bu)**
 - **Our climate and soils are much different than other areas... therefor different N demands**
 - **Ability to adapt and adjust to each year**
- **Better predict supplying power of soil, mineralization**
- **Determine best combination of time, place, and source**
- **Evaluate accuracy of in-season decision tools**

Treatments

#	Planting				In Season			
	rate	time	place	source	rate	time	place	source
1	0							
2	40	pre-plant	broad +incorp	urea				
3	80	pre-plant	broad +incorp	urea				
4	120	pre-plant	broad +incorp	urea				
5	160	pre-plant	broad +incorp	urea				
6	200	pre-plant	broad +incorp	urea				
7	80	pre-plant	broad +incorp	Super U				
8	120	pre-plant	broad +incorp	Super U				
9	80	pre-plant	broad +incorp	eNtrench urea				
10	120	pre-plant	broad +incorp	eNtrench urea				
11	80	pre-plant	broad +incorp	ESN: Urea (1:1)				
12	120	pre-plant	broad +incorp	ESN: Urea (1:1)				
13	40	post-plant	broadcast	Super U				
14	80	post-plant	broadcast	Super U				
15	120	post-plant	broadcast	Super U				
16	40	post-plant	broadcast	Super U	40	V4	side-dress	UAN
17	40	post-plant	broadcast	Super U	80	V4	side-dress	UAN
18	40	post-plant	broadcast	Super U	40	V6	dribble-band	UAN
19	40	post-plant	broadcast	Super U	80	V6	dribble-band	UAN
20	40	post-plant	broadcast	Super U	40	V6	dribble-band	UAN+ agrotain
21	40	post-plant	broadcast	Super U	80	V6	dribble-band	UAN+ agrotain

Rate

Source

Place

Time

Measurements

- pre & post harvest soil nitrate to 48"
- pre-sidedress nitrate
- estimated mineralizable N
- leaf reflectance
- grain yield, moisture, N content
- stalk nitrate content
- rainfall, temperature, soil moisture, soil texture
- plant height, leaf measurements



Looking for Potential Sites

Two types of sites being sought:

- **2 sites each yr. planted & managed by U of MB**
- **6 sites each yr. planted and sprayed by farmer, but fertilized and harvested by U of MB**

Site selection will depend on many factors including:

- **Within a corn field**
- **Variety of soil types**
- **Far enough apart to vary weather conditions, but reasonably close for travel time**
- **Enthusiastic farmers**
- **Very low residual nitrogen (0-24" tests)**
- **No fall or spring applied N fertilizer or manure**



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