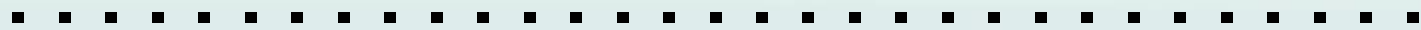


Fueling Corn Yields through 4R Management of Nitrogen



John Heard and Curtis Cavers

MB Ag

AAFC

CCA

CCA

Manitoba



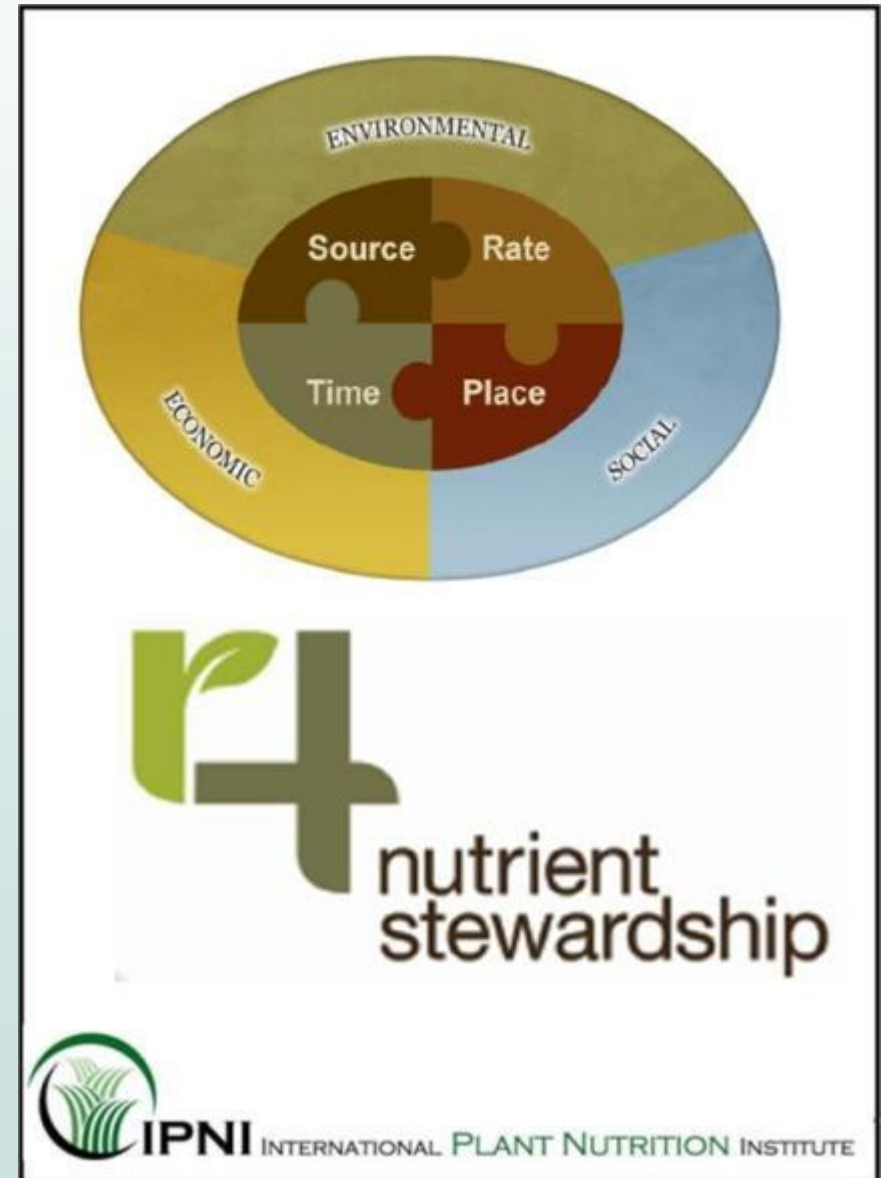
Introduction

- Corn acreage and yield increases
- Review of N management studies and practices

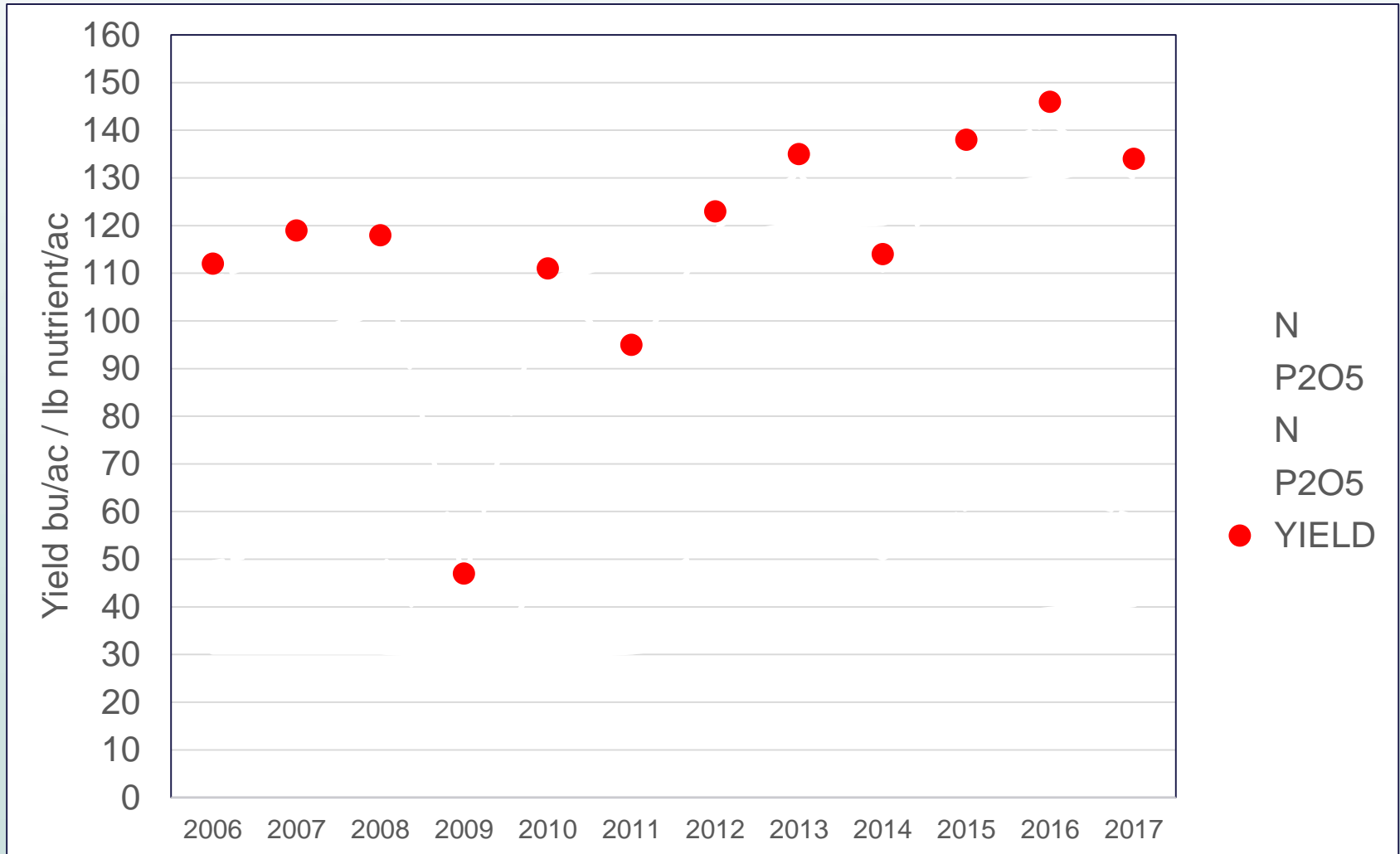
- 4R Nutrient Stewardship
- The Rights

4R Nutrient Stewardship

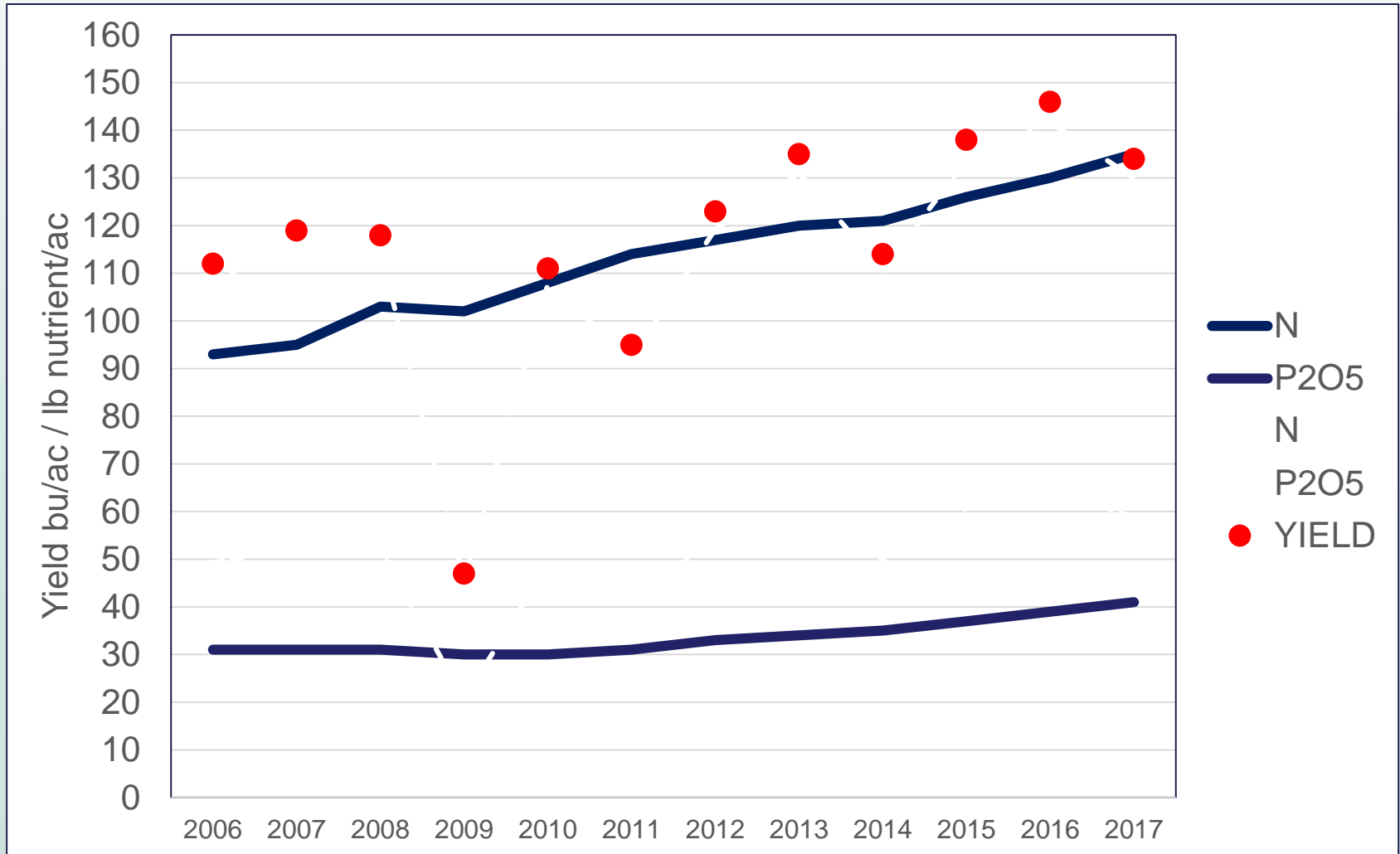
- ✓ Right rates
- ✓ Right sources
- ✓ Right placement
- ✓ Right timing



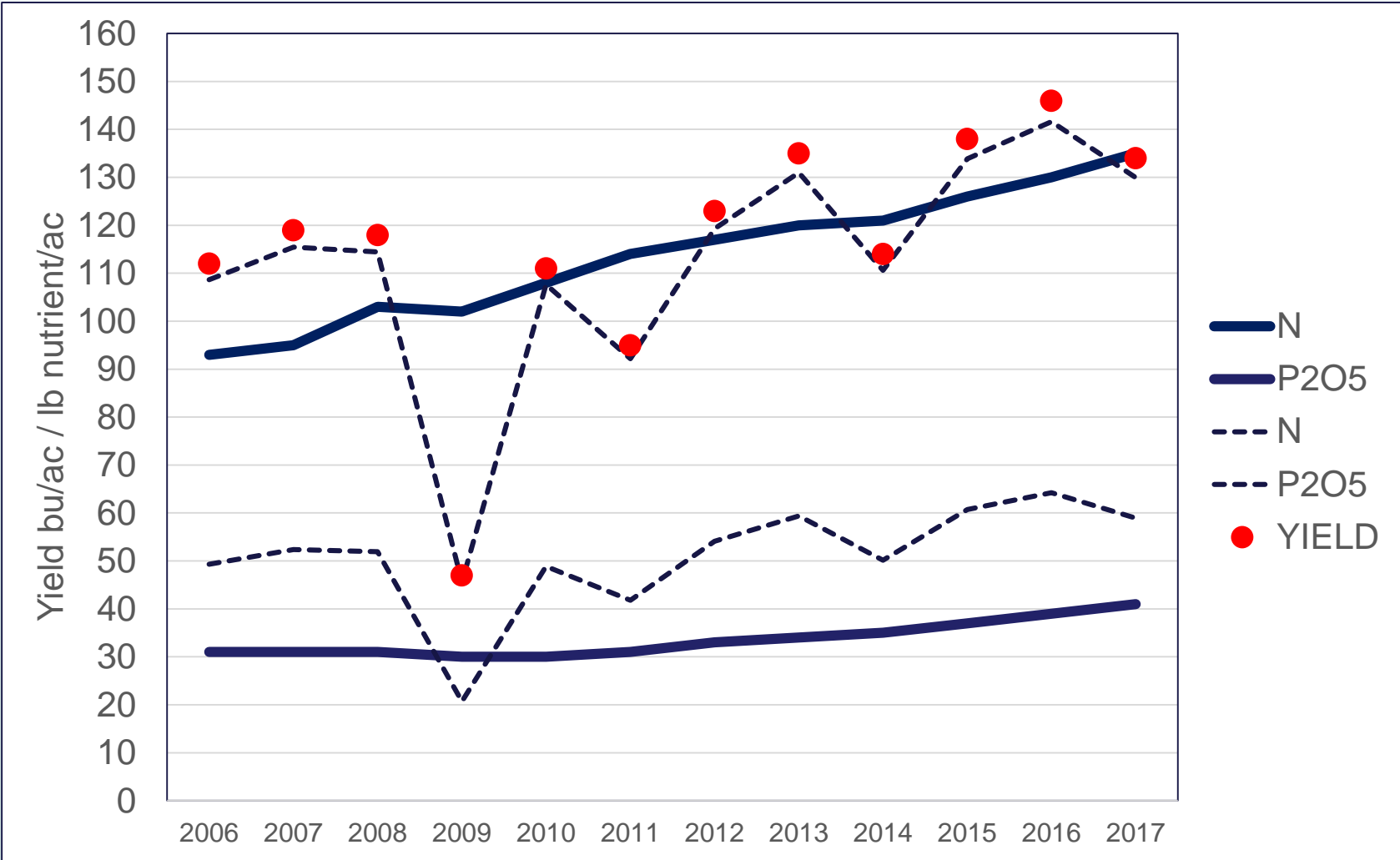
MB Corn Yield, N applied, **Manitoba** removed



MB Corn Yield, N applied, **Manitoba** removed



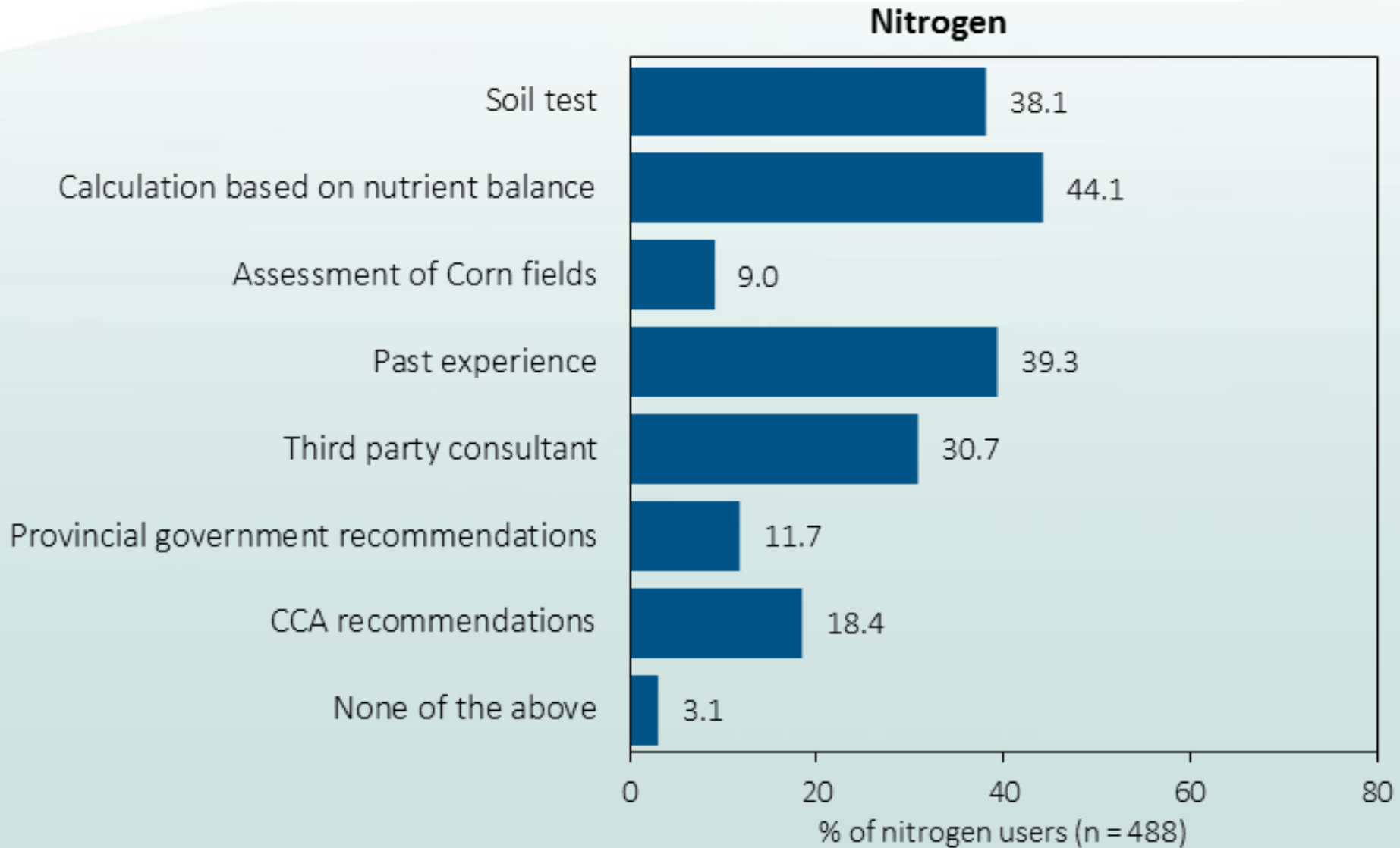
MB Corn Yield, N applied, **Manitoba** removed



A) What criteria do you use for N rates?

- A. yield goal, soil test and lb N/bu
- B. A N Rate Calculator
- C. Past experience
- D. Estimate Organic Matter release
- E. Other

Approaches Used to Decide N Rate in Corn – E Canada



- Last corn N research at U of MB was 1981-1983
- MB Soil Fertility Guide (2007) and the guide to Corn Prod'n in MB (2004) guidelines top out at 130 bu/ac
- For a yield goal of 130 bu/ac and a soil test with 30 lb N/ac, MSFG and CPM recommend 195 lb N/ac and 225 lb N /ac, respectively ... **1.7 and 2.0 lb total N/bu**
- Agvise recommendation for the same scenario would be 156 lb N/ac ... **1.2 lb total N/bu**
- New recommendations from NDSU vary with growing area and corn vs. fertilizer prices, but average **1.15 lb total N/bu** for eastern ND

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):

4.00

Input Nearest Nitrogen Cost (\$/Pound):

0.60

Soil Test for Nitrogen Analysis (lbs/acre 2-ft depth):

40

Percent Organic Matter In Soil:

4

Previous Crops Planted

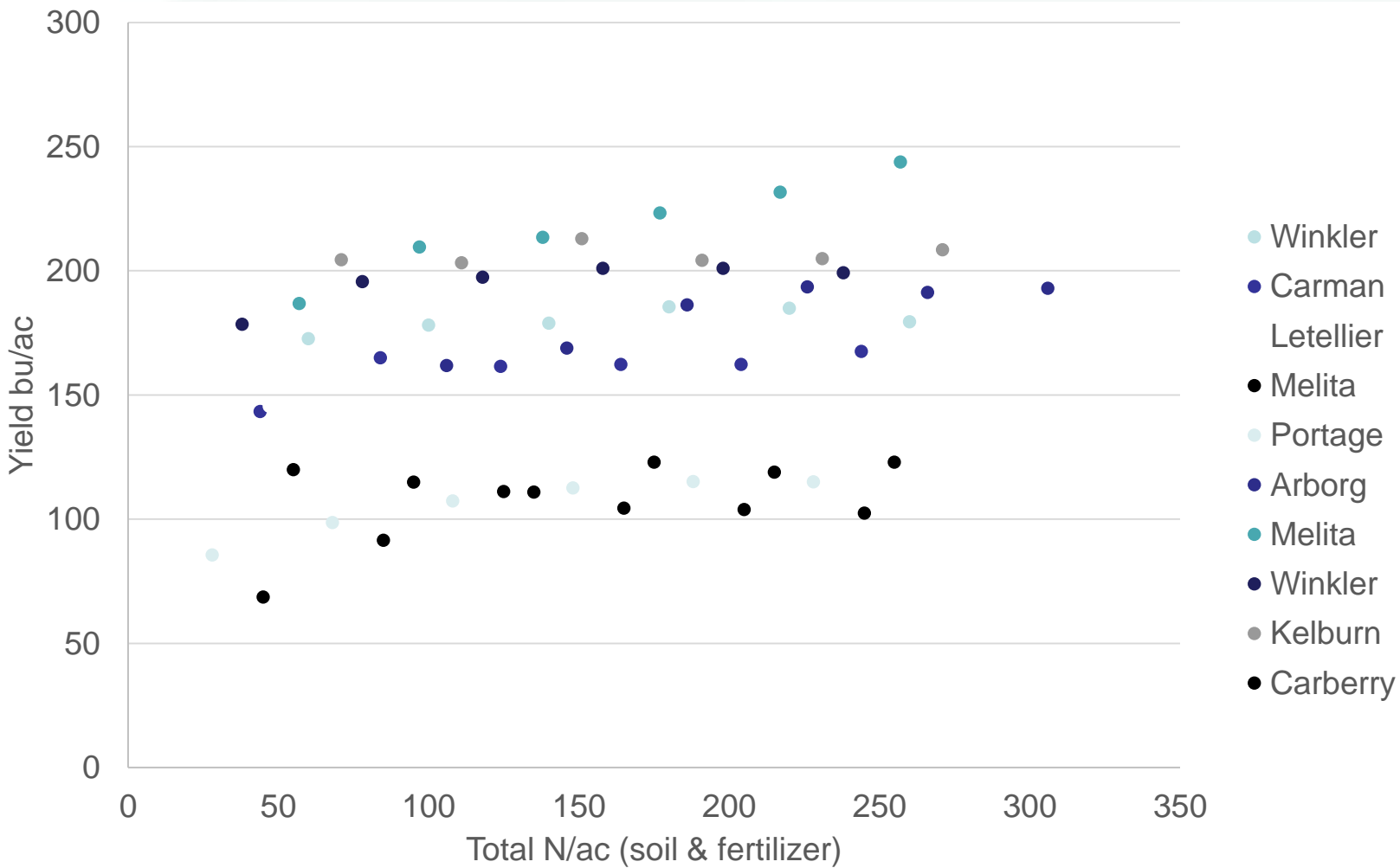
- No nitrogen-supplying crop
 Soybean, Field Pea, Dry Bean, Lentil, Chickpea or harvested Sweet Pea
 Sugarbeet with yellow-green leaves
 Sugarbeet with green leaves
 Harvested Alfalfa or unharvested Sweet Clover (>5 plants/sq-ft)
 Harvested Alfalfa or unharvested Sweet Clover (3-4 plants/sq-ft)
 Harvested Alfalfa or unharvested Sweet Clover (1-2 plants/sq-ft)
 Harvested Alfalfa or unharvested Sweet Clover (less than 1 plant/sq-ft)

Nitrogen Recommendation: 110

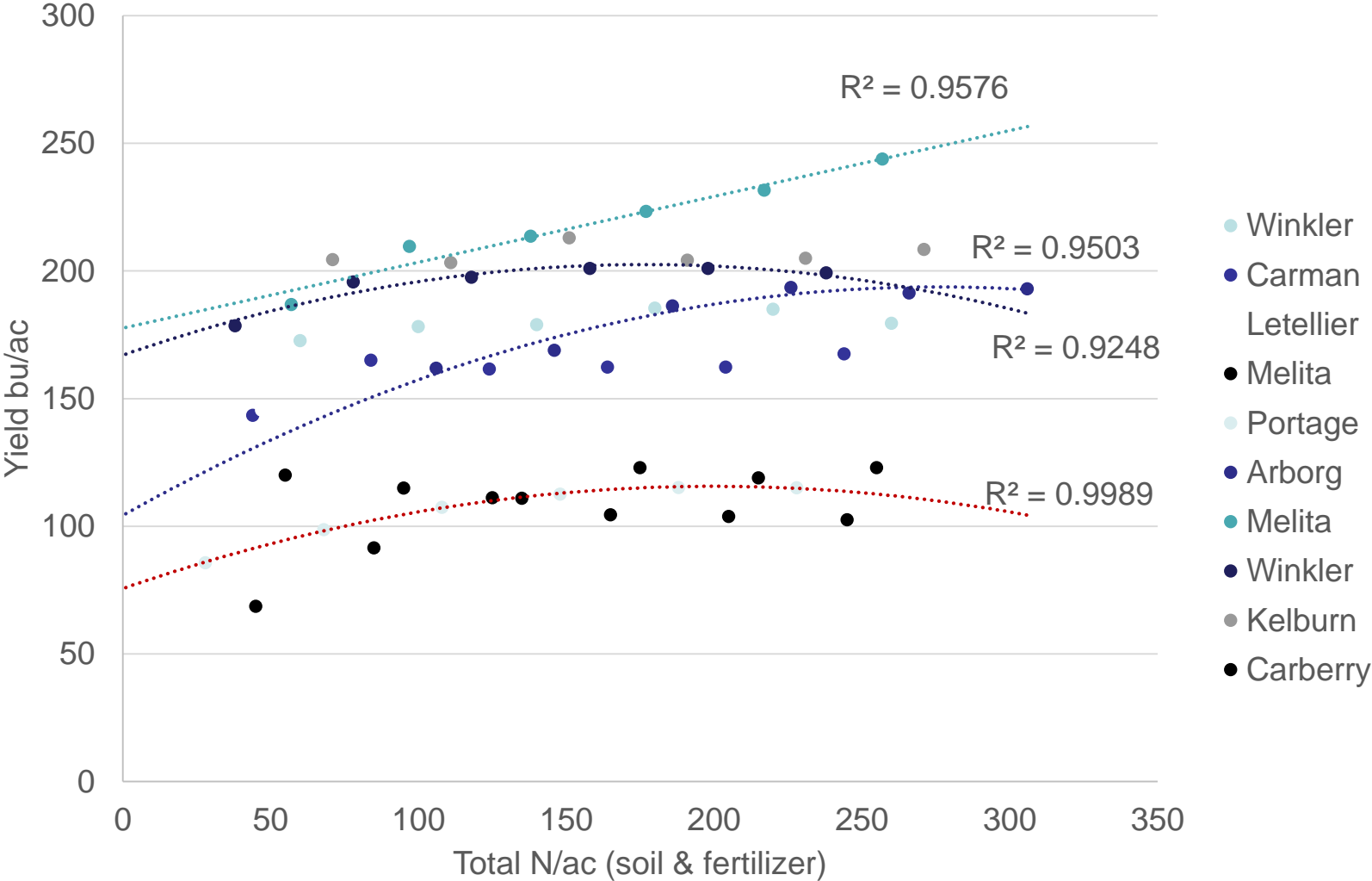
plus/minus 30 lbs.

These soils would benefit greatly from a sidedress N application due to their high susceptibility to leaching in all but the driest of years. Base preplant rates on the Nitrogen Recommendation Rate Calculator above. Base side-dress rate on the medium-textured soil with historic yields greater than 160 bushels per acre less whatever base rate, residual N and N credits are given in the Calculator above. A better sidedress rate strategy would be to apply an N-rich strip preplant and use the active-optical sensor algorithm for the medium-textured soil with historic yields greater than 160 bushels per acre. If there is significant rain that might contribute to N leaching between preplant N application and sidedress, the N-rich strip might have to be reapplied about a week before sidedress application.

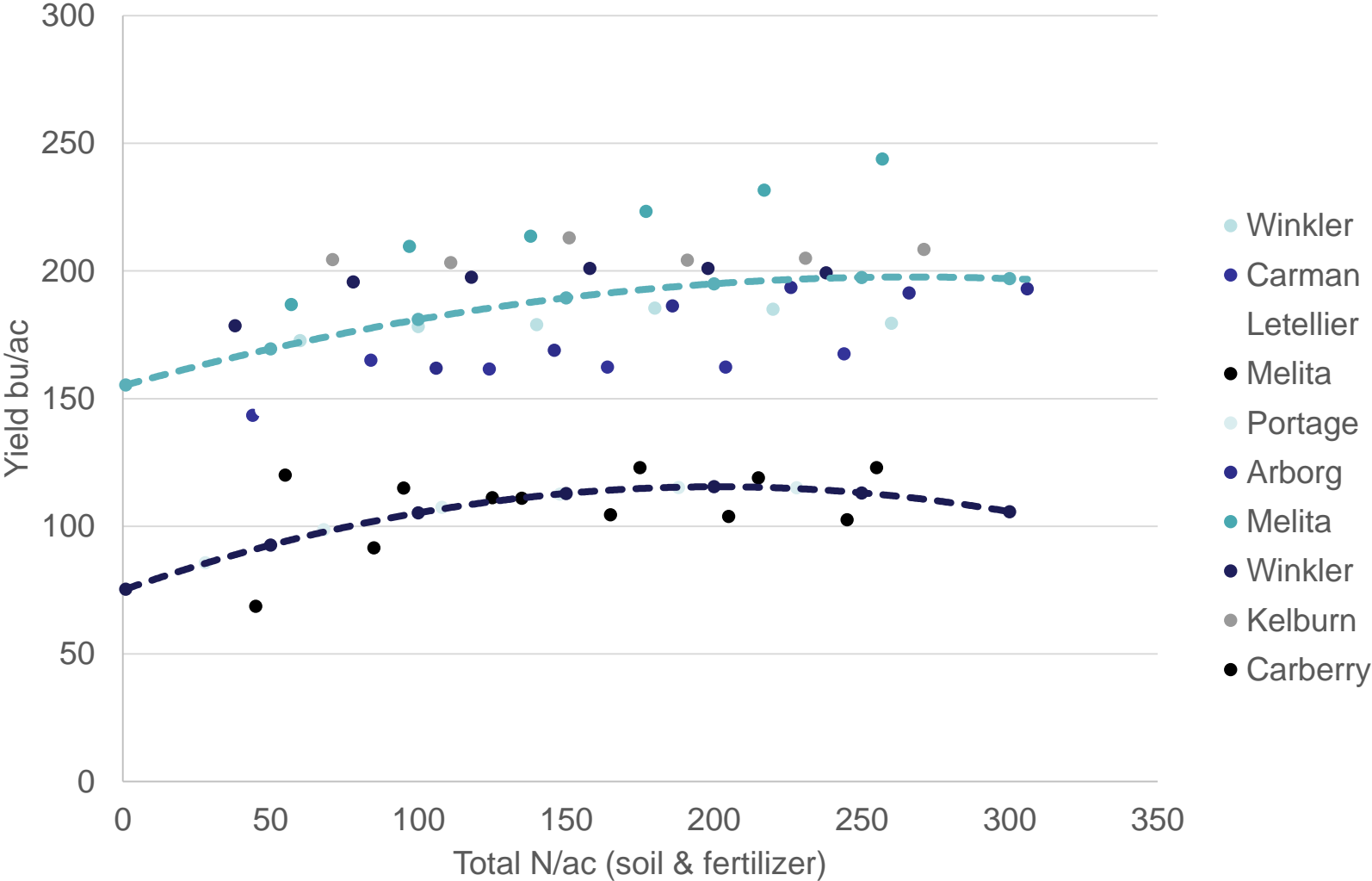
Results – MCGA 2016-17



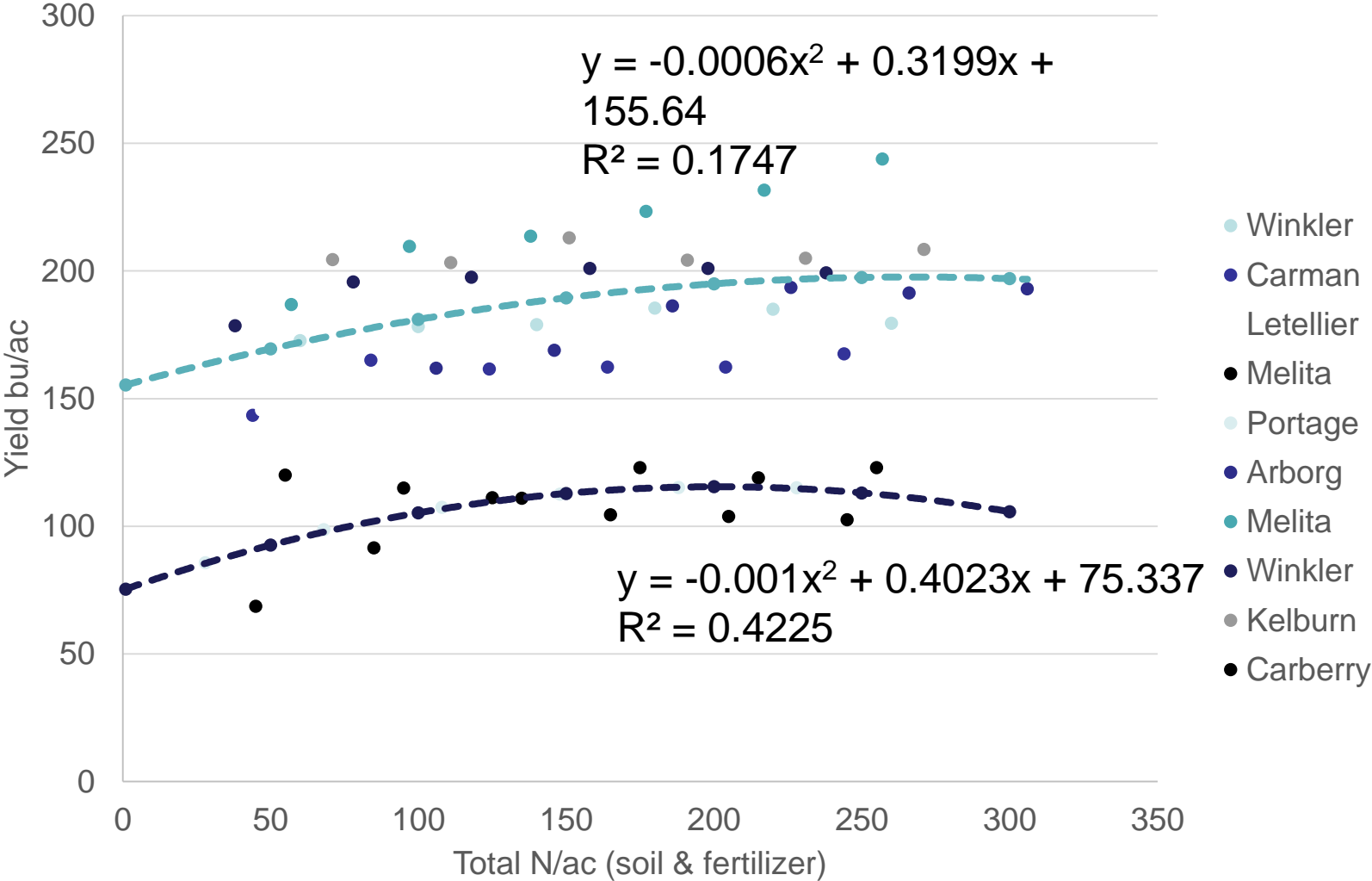
Results – MCGA 2016-17



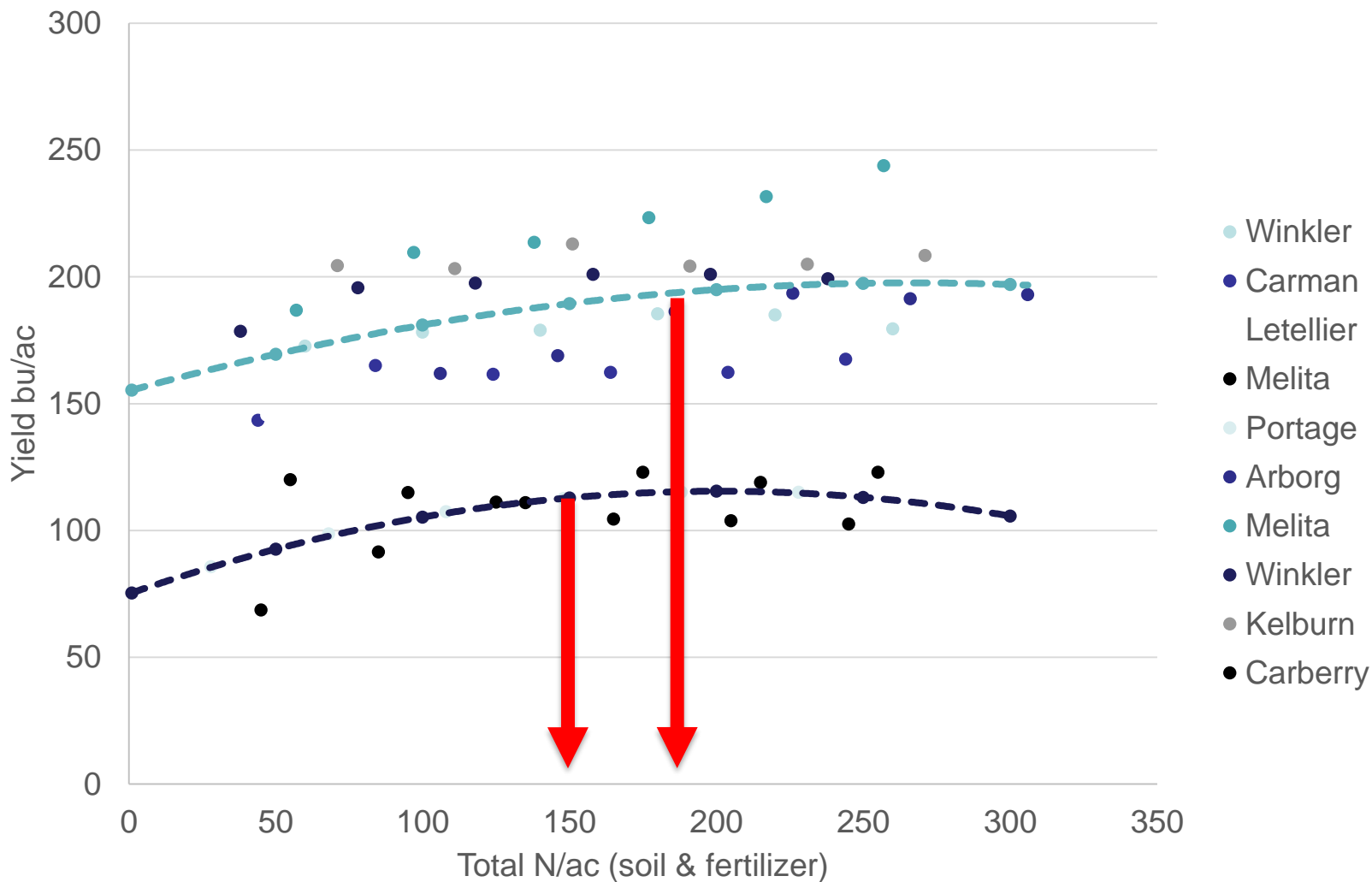
Results – MCGA 2016-17



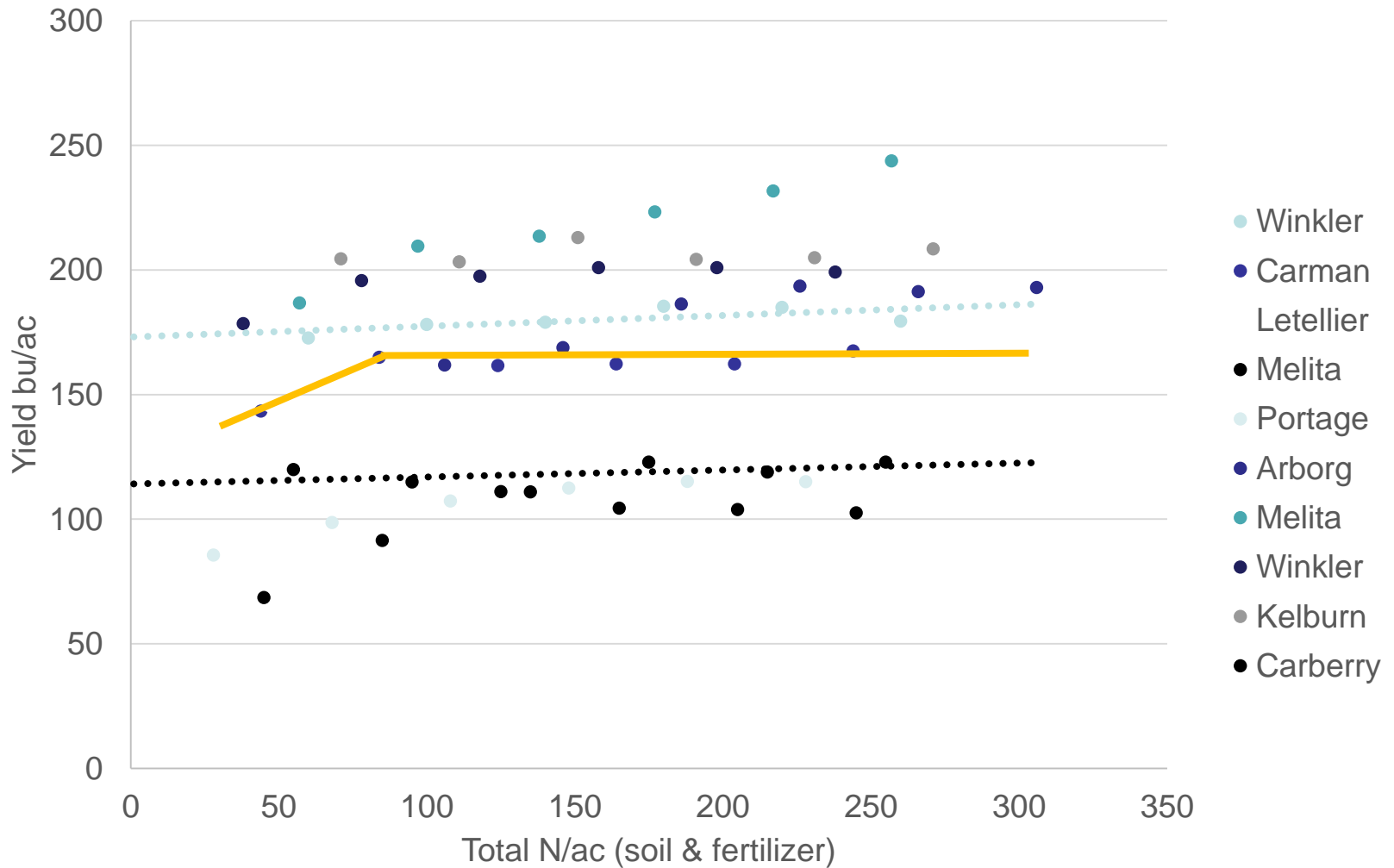
Results – MCGA 2016-17



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



But missing opportunities to fine tune



What are we missing?

N Release

Soil Health



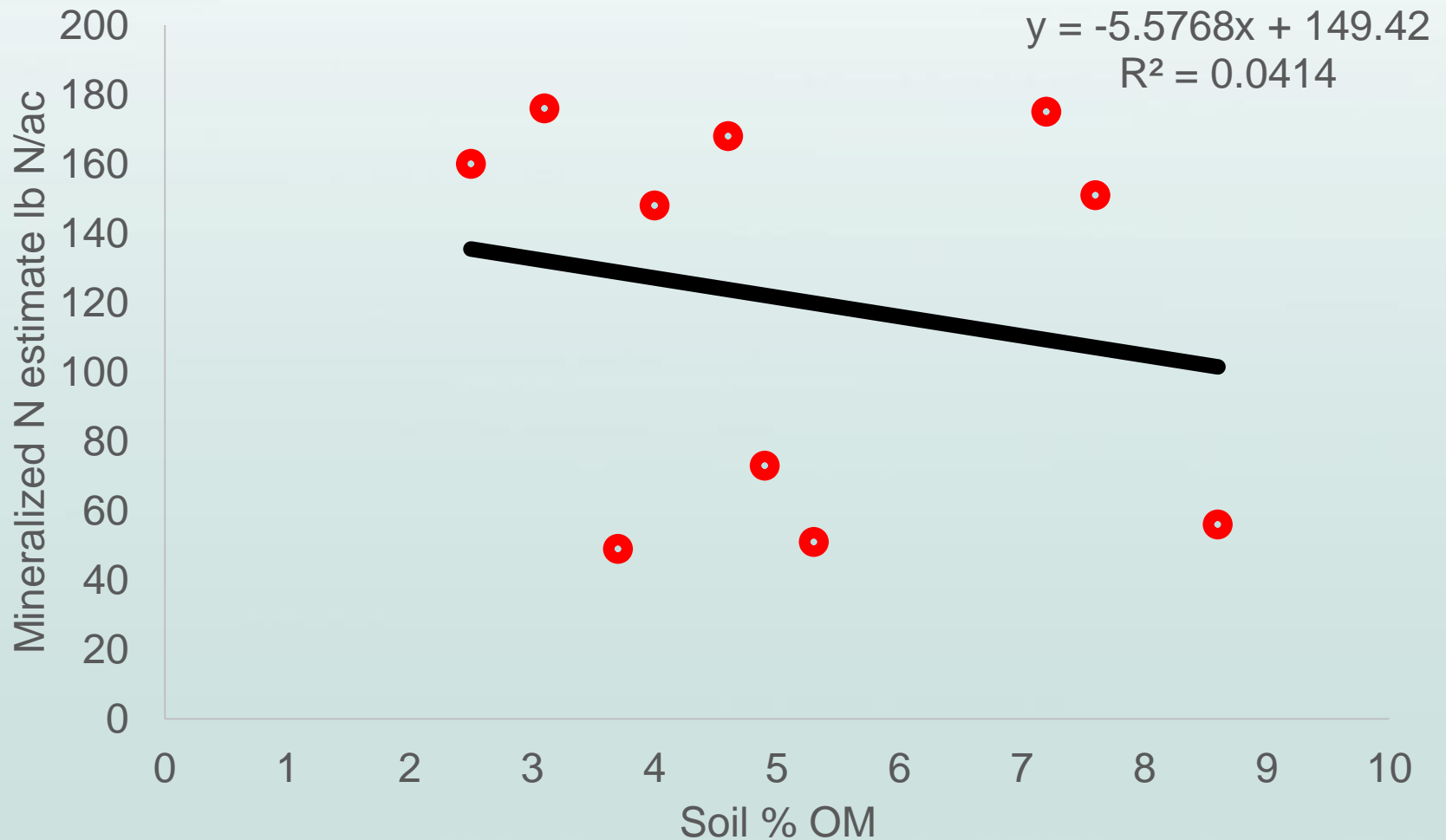
Mineralization amounts?



Site	Check Yield	Est .N uptake ³	Soil nitrate 0-2	Starter fertilizer N	Mineralized N est.
	Bu/ac		lb N/ac		
St Adolph	202	226	71	4	151
Carberry	120	134	55	6	73
Arborg	154	172	106	10	56
Morden	178	199	35	4	160
Melita	187	209	57	4	148
Winkler	173	194	18**	-	176
Carman	143	160	-8**	-	168
Letellier	146	164	-11**	-	175
Melita	69	77	28	-	49
Portage	86	96	45	-	51

The estimate is based on using a 1.12 lb whole plant N uptake/bu⁴ less soil nitrate, less starter fertilizer N.

Estimate Mineralization by OM?



Future opportunities

- ADAPTIVE MANAGEMENT
- Start with base N
- Adjust rate with more knowledge

Soil (PSNT)



Canopy Sensors



Weather



Who might aid estimate of in-season mineralization (and losses)?

ADAPT-N

- Cornell University



Climate Corporation

- Monsanto



Encirca

DuPont/Pioneer



FarmCommand
N Manager

FARMCOMMAND™

FarmCommand | N-Manager

N-Manager

Subfiled 1 (Scenario: Corn, Grain-May 2)

No additional nitrogen needed

Waiting for Planting

Error calcula

Zone: 1	Zone: 2	Zone: 3	Zone: 4
Status: Good	Status: Warning	Status: Warning	Status: Warning
Checkstrip: No	Checkstrip: No	Checkstrip: No	Checkstrip: No
Last Updated: 2016-06-13 09:51am	Last Updated: 2016-06-13 09:51am	Last Updated: 2016-06-13 09:51am	Last Updated: 2016-06-13 09:51am
Yield Target: 180 bu/acre	Yield Target: 200 bu/acre	Yield Target: 200 bu/acre	Yield Target: 210 bu/acre
Area: 25.33 Acres	Area: 40.43 Acres	Area: 40.43 Acres	Area: 47.53 Acres
V6 Date: 31-05-2016	V6 Date: 31-05-2016	V6 Date: 31-05-2016	V6 Date: 31-05-2016
Predicted Yield: 192bu/acre	Predicted Yield: 202bu/acre	Predicted Yield: 202bu/acre	Predicted Yield: 212bu/acre
Recommended side-dress rate: 70lbs/acre	Recommended side-dress rate: 70lbs/acre	Recommended side-dress rate: 70lbs/acre	Recommended side-dress rate: 85lbs/acre

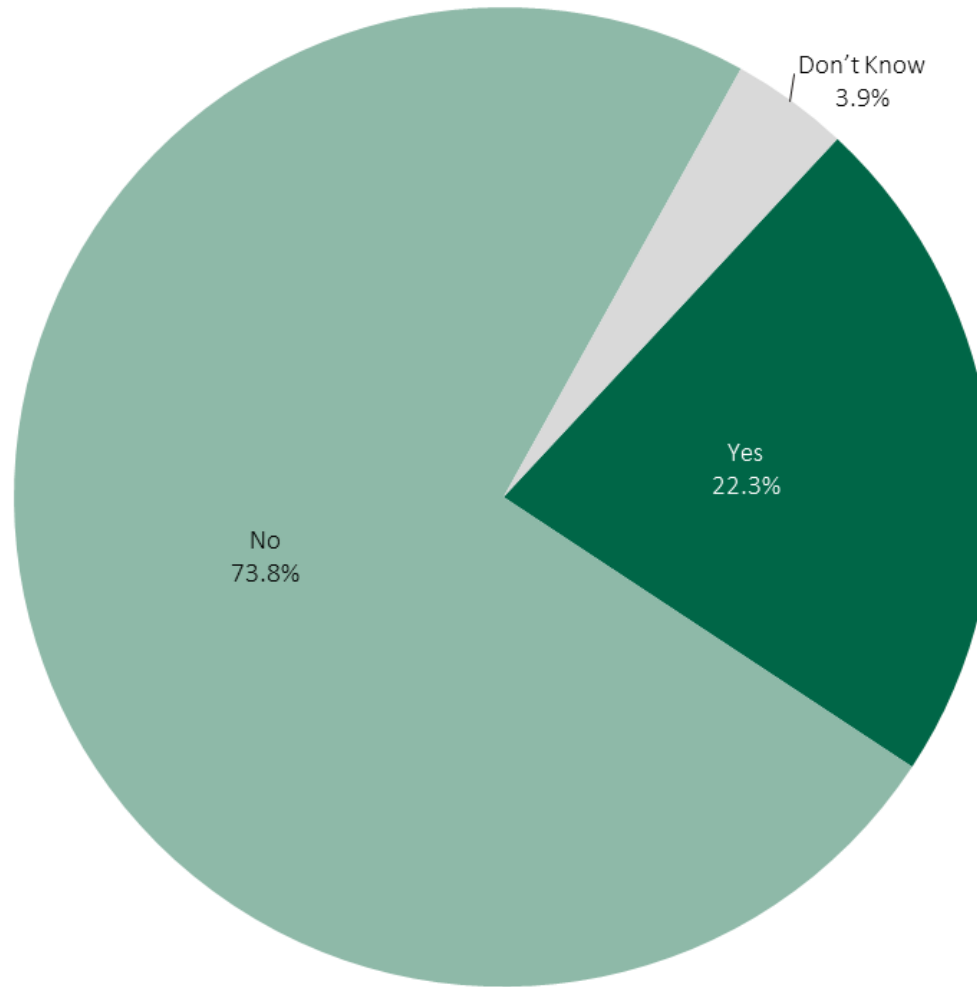
are currently under nitrogen stress

N Source

B) Which Enhanced Efficiency fertilizer have you used in corn?

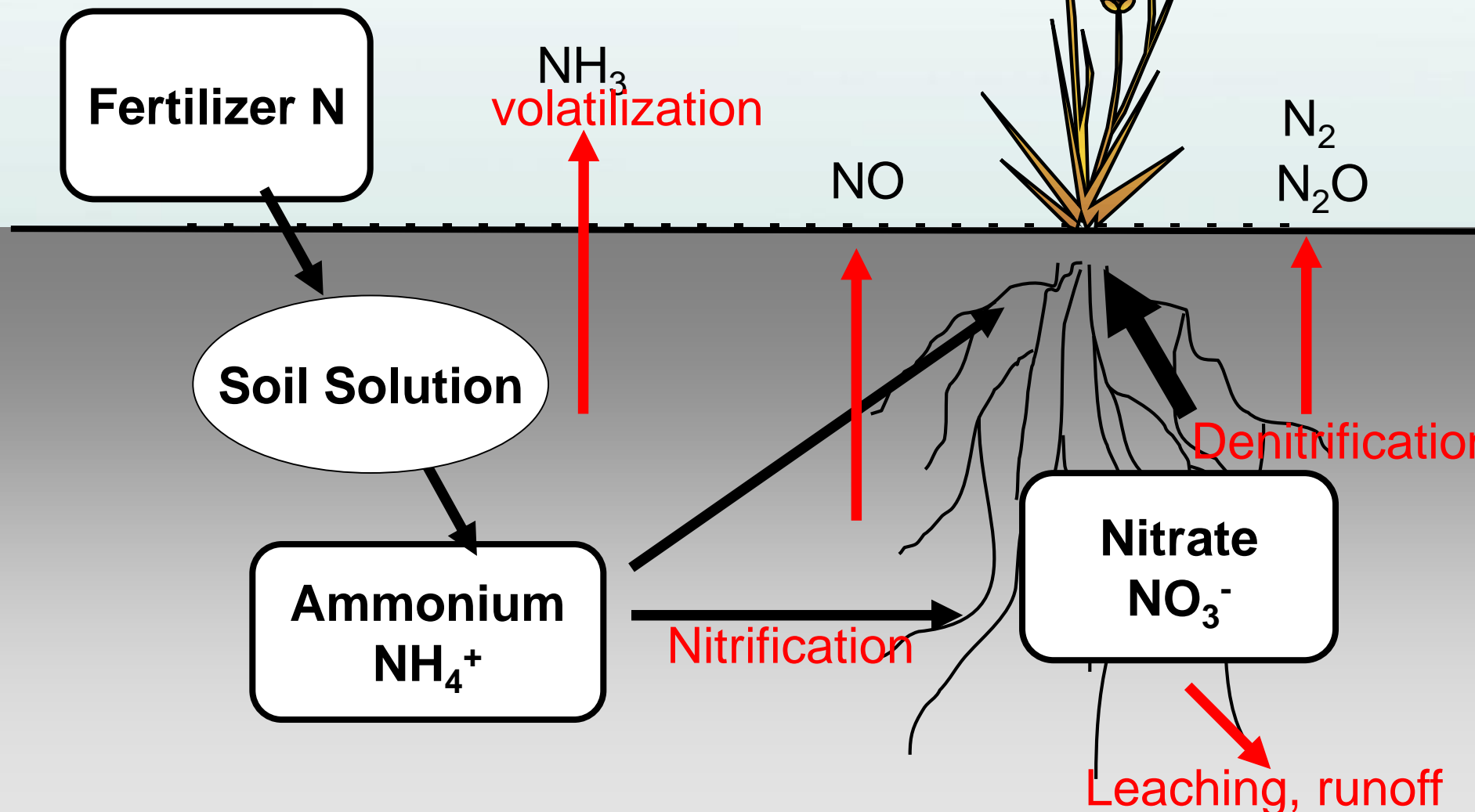
- A. None
- B. ESN
- C. SuperU
- D. eNtrench, N-Serve
- E. Agrotain

Use of Nitrogen Stabilizer in Corn

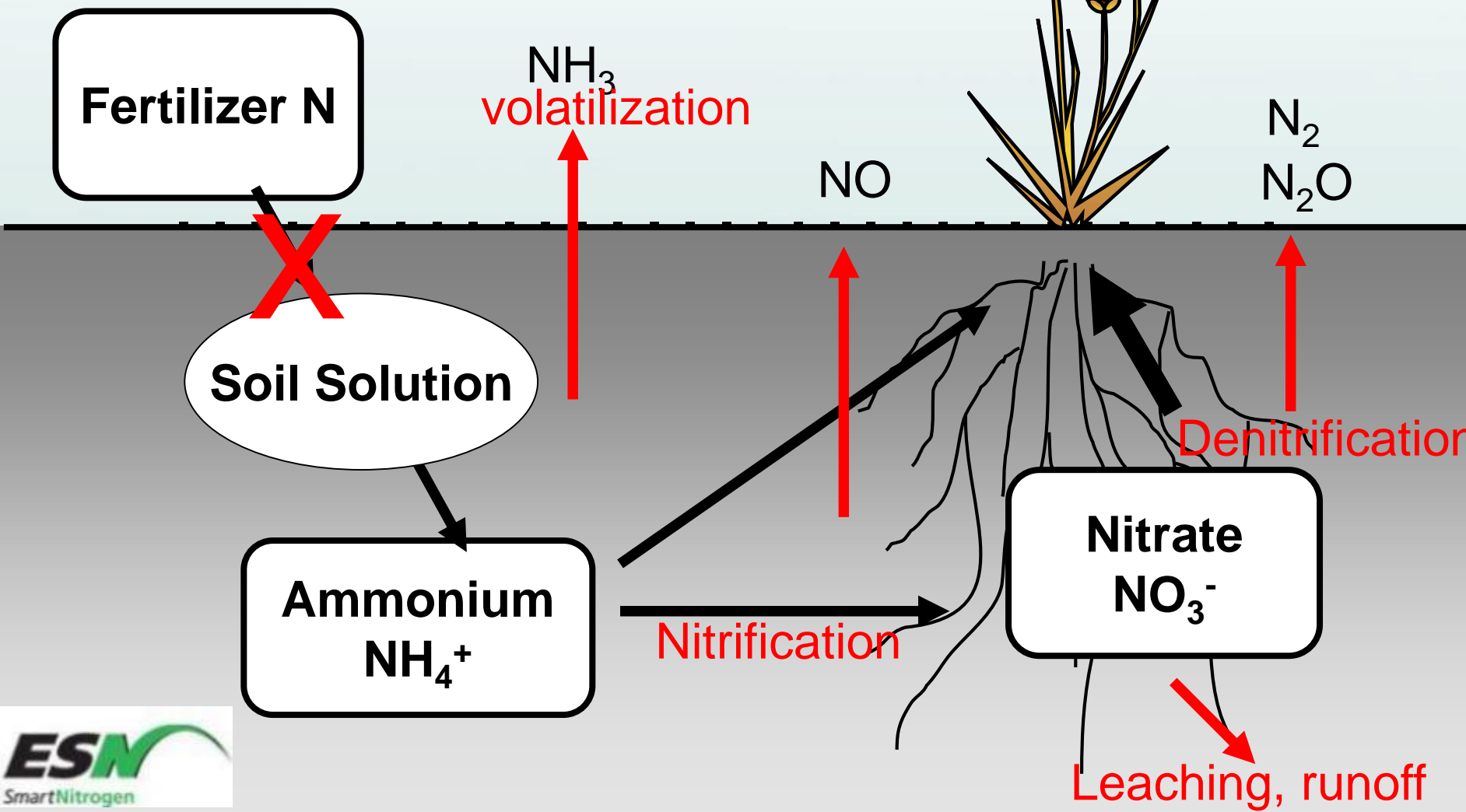


% of those corn growers who used a Nitrogen fertilizer (n = 488)

Enhanced Efficiency Products work on Loss Pathways of N Cycle

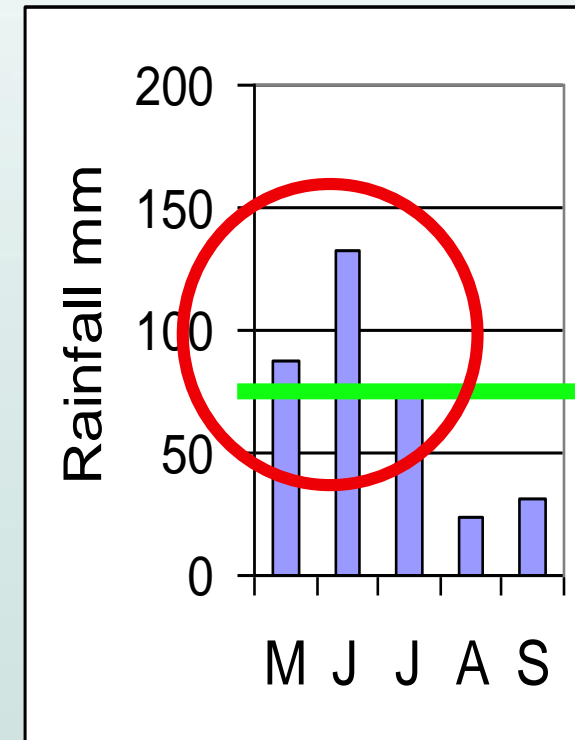
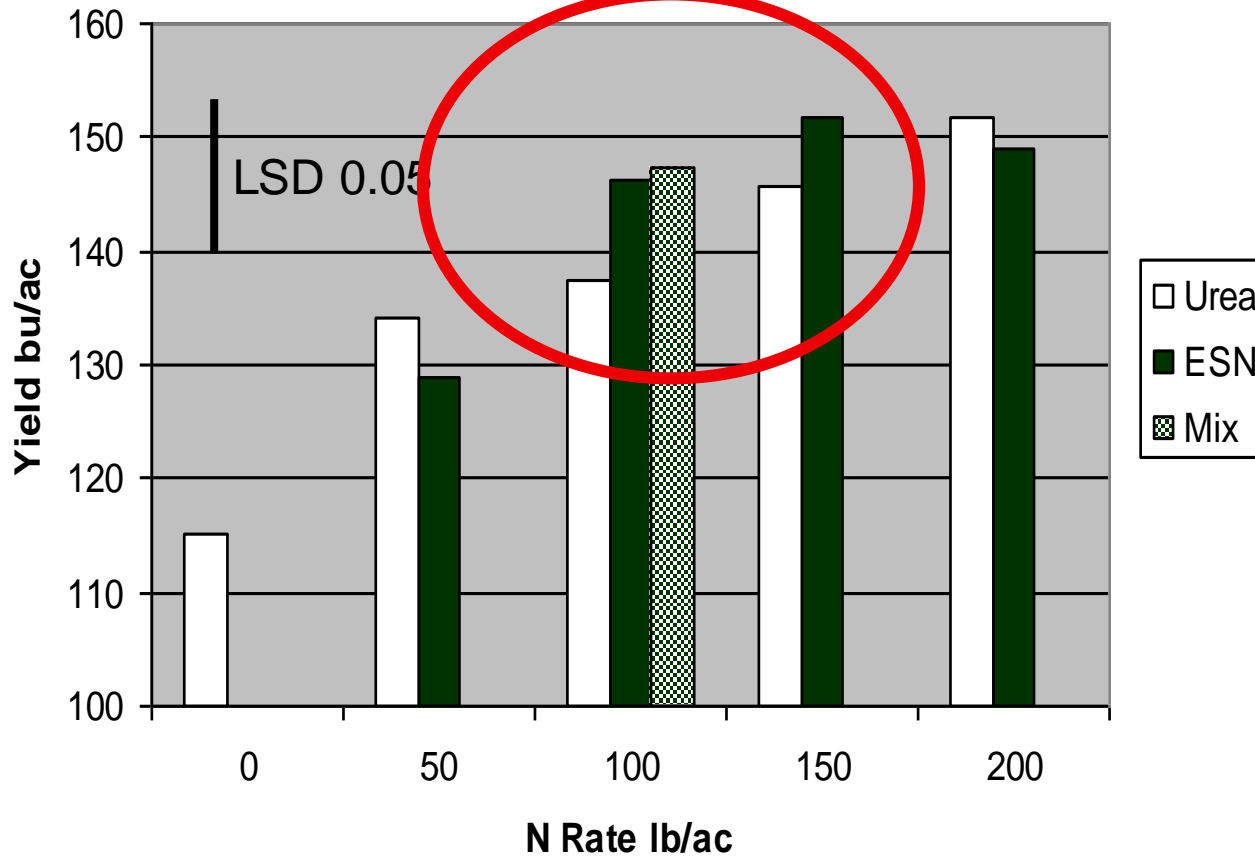


Slow and Controlled Release Products Delay Release of Fertilizer into Solution



ESN on corn – wet year

Carman 2005

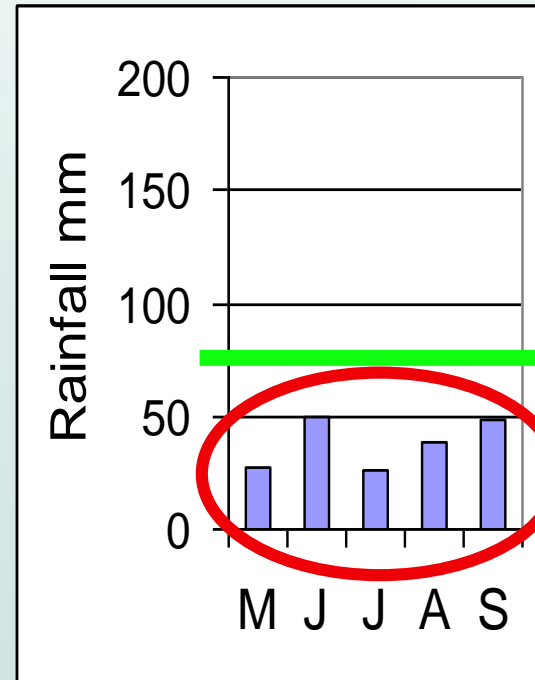
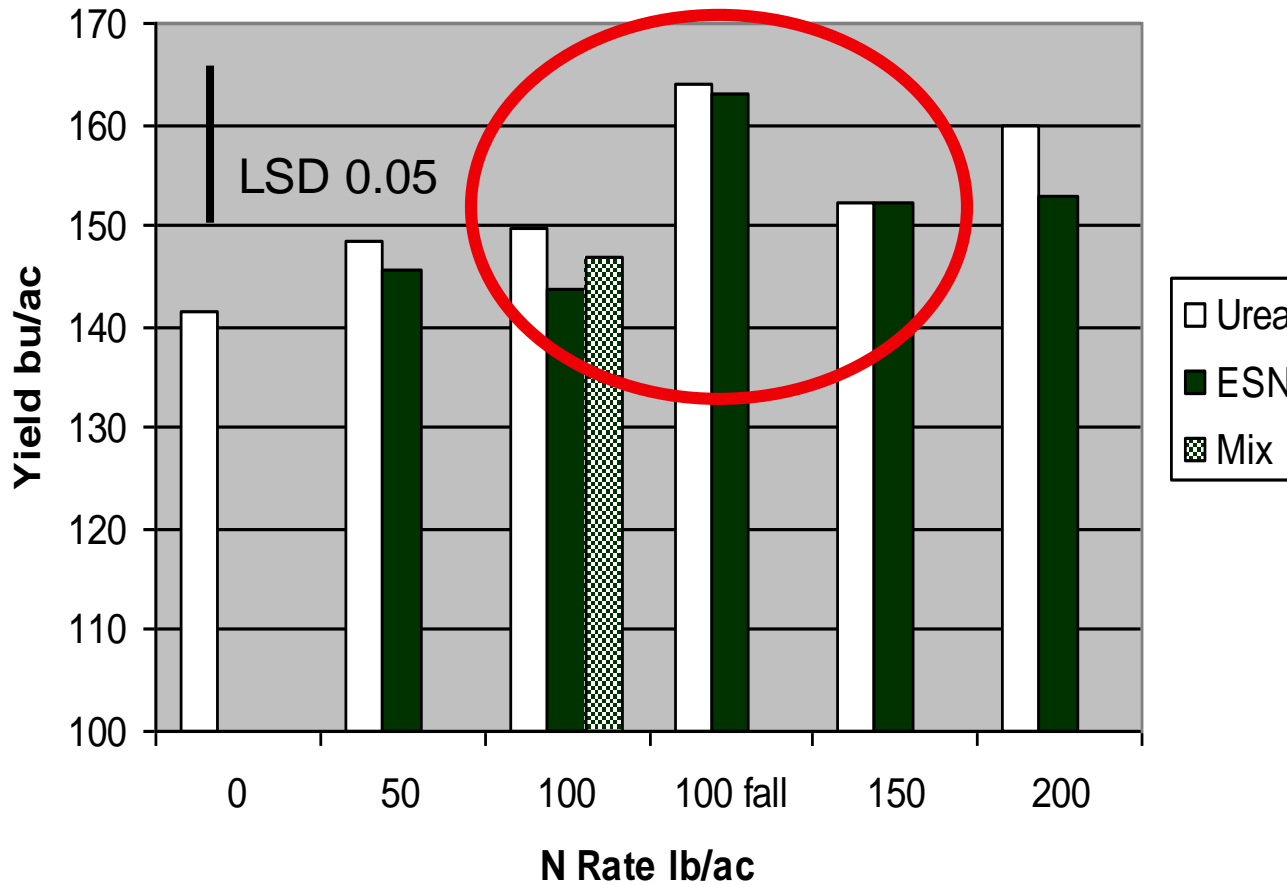


Heard, 2008

ESN on corn – dry year

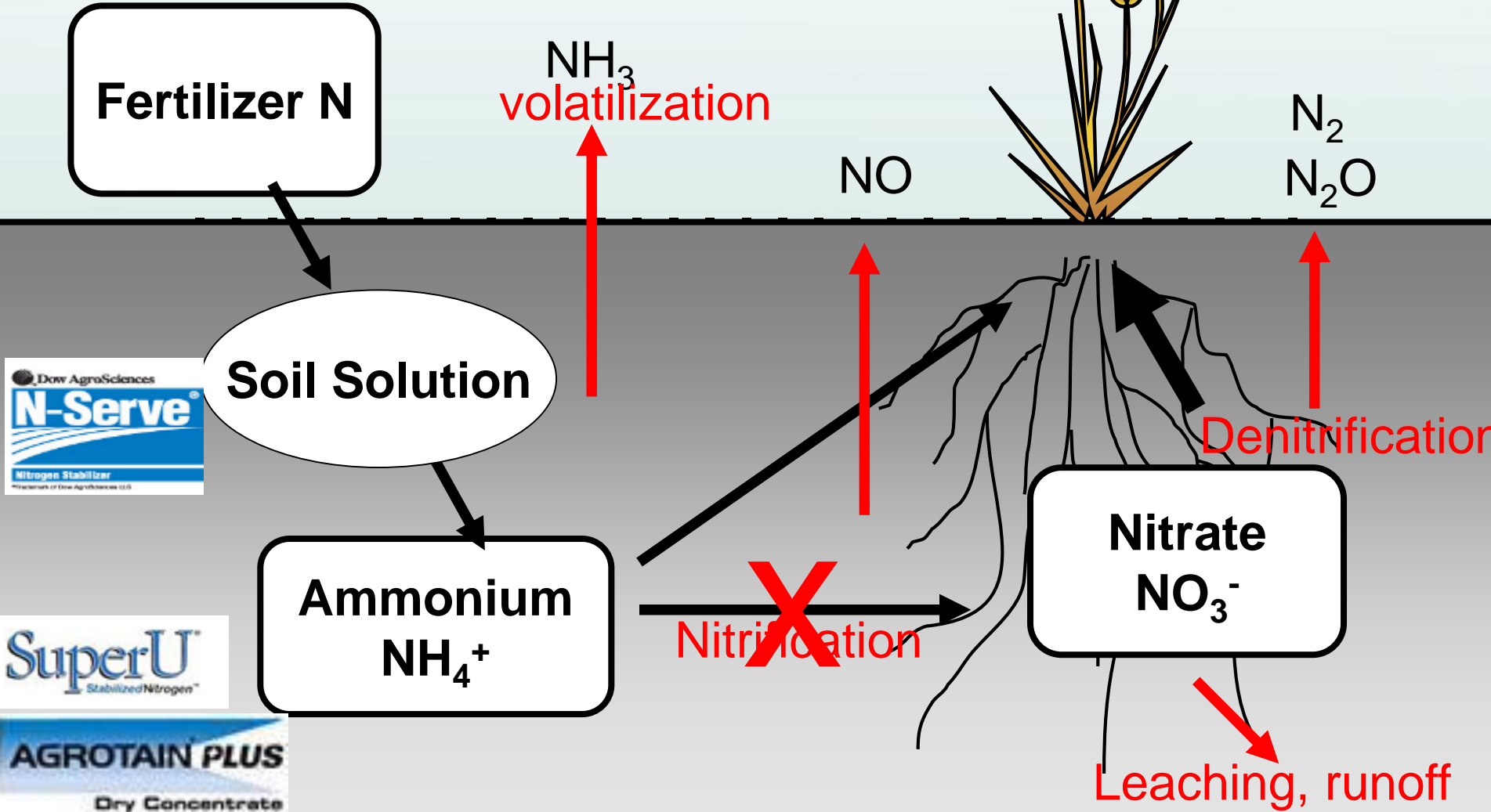


Carman 2006



Heard, 2008

Nitrification Inhibitors slow conversion to nitrate-N

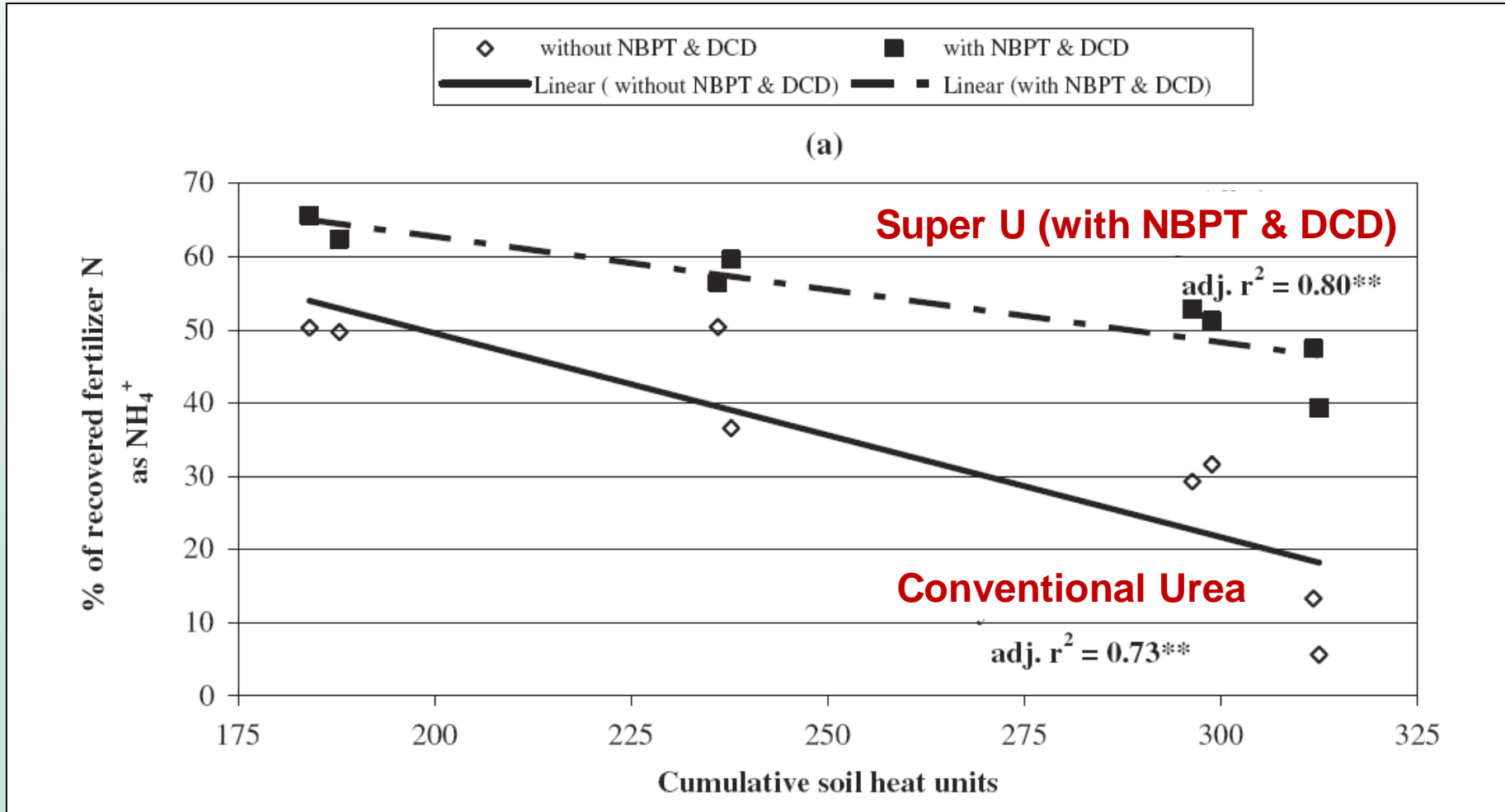


Nitrified N Over Time & N Source

N Source	Weeks after application		
	0	3	6
		% of fertilizer as NO ₃ -N	
Anhydrous Ammonia (AA)	0	20	65
AA + nitrapyrin (N-Serve)	0	10	50
Urea	0	50	75
Urea + nitrapyrin (eNtrench)	0	30	70
UAN solution	25	60	80
Ammonium nitrate	50	80	90

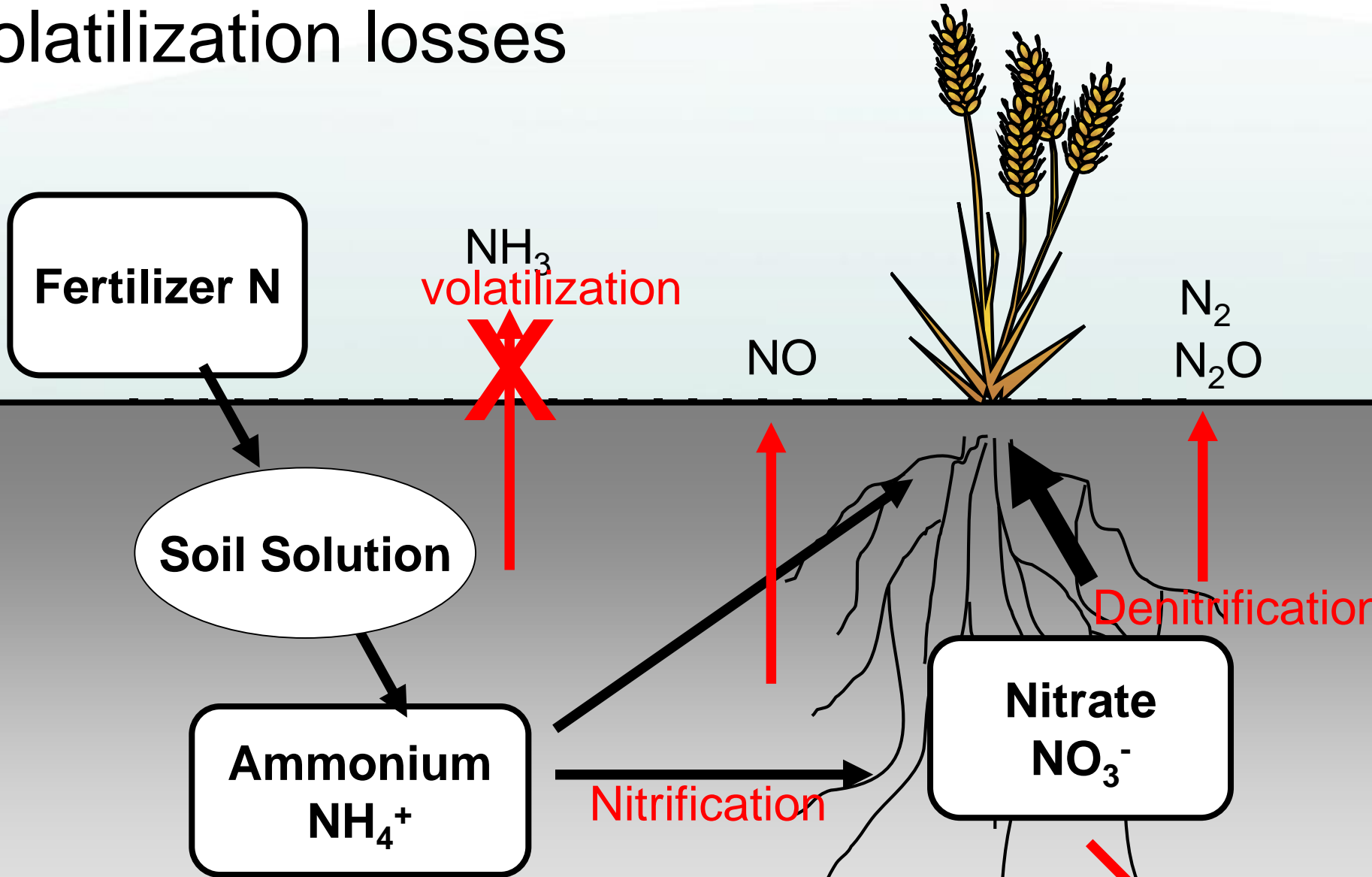


Inhibitors slowed the conversion of urea and NH_4^+ -N to nitrate in Manitoba studies with fall applied urea

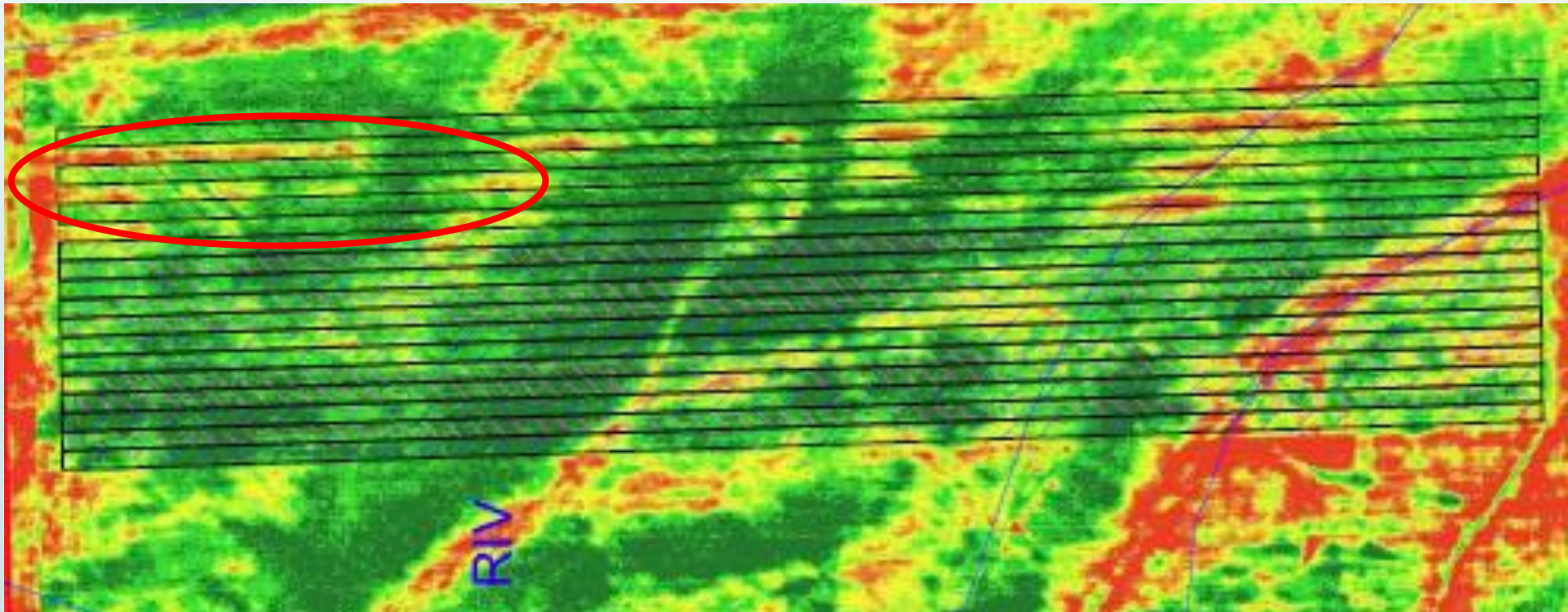


(Tiessen et al. 2006, Agron J)

Urease Inhibitors slow volatilization losses



N Response varies by drainage



Little difference between N rates in well drained areas

MCGA, 2017
New Bothwell site



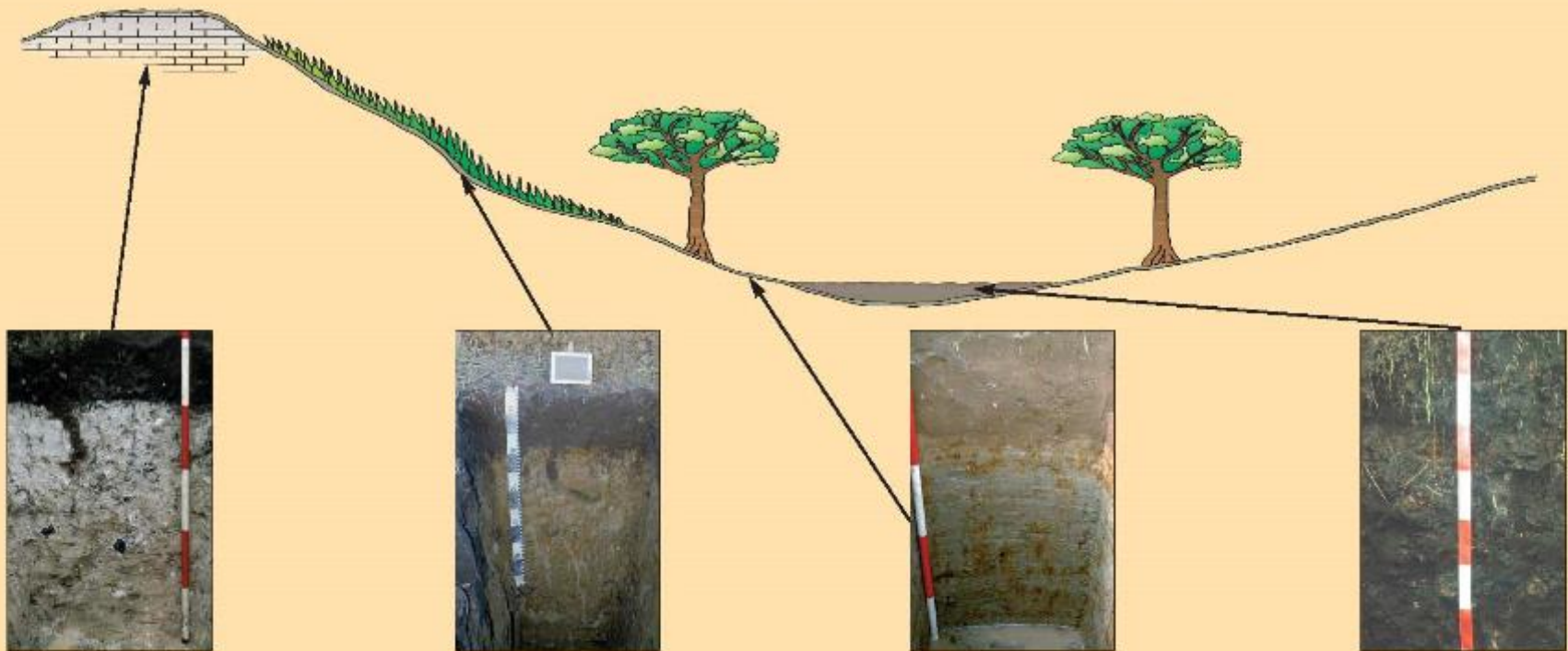
Opportunity for variable source application?

Soil Landscapes, Drainage

Imperfectly and poorly drained soils in relation to topography.

The series of photographs below illustrates a topographically related sequence of soils known as a **catena** (a term derived from the Latin meaning a chain); soil profiles are linked together when traced down a slope from the ridgeline to the valley floor. Soils change character according to slope angle and drainage conditions.

On the crest of the landscape we find thin soils with underlying parent materials very close to the surface. These are usually Regosols. On the slope towards the valley the precipitation surplus can leach nutrients laterally or vertically and leached profiles can be found if the local conditions permit the formation of deep soil. In the valley bottom we can find groundwater gley at shallow depths. In the centre of the valley, peat formation has taken place and thick layers of fen peat have developed. The nature of the parent material can be important.



A shallow soil. (HBM)

Leaching. (HBM)

Waterlogging leading to gleyic conditions. (HBM)

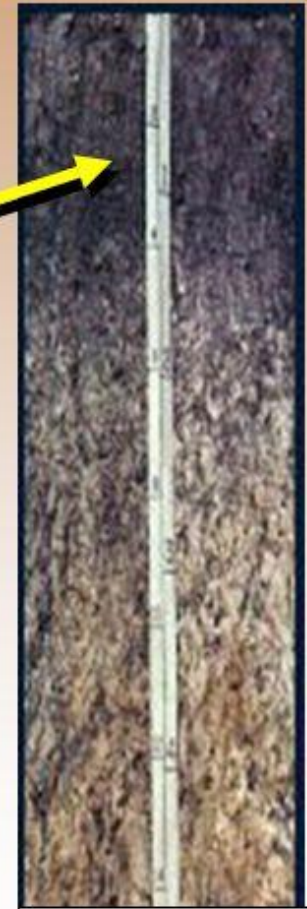
A fen peat. (LM)

Soil Color Tells A Story

Drainage on this farm?



**Well
Drained**

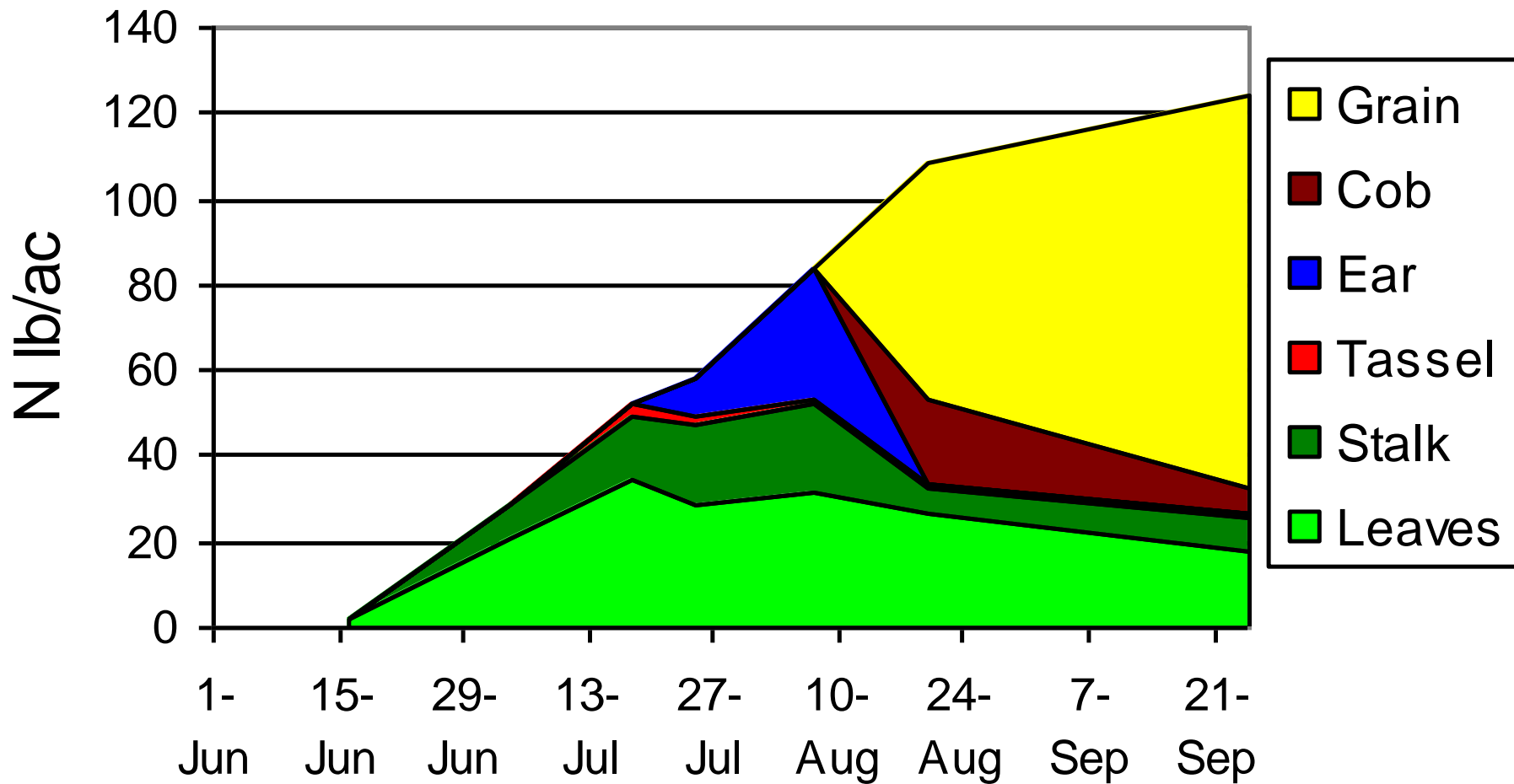


**Poorly
Drained**

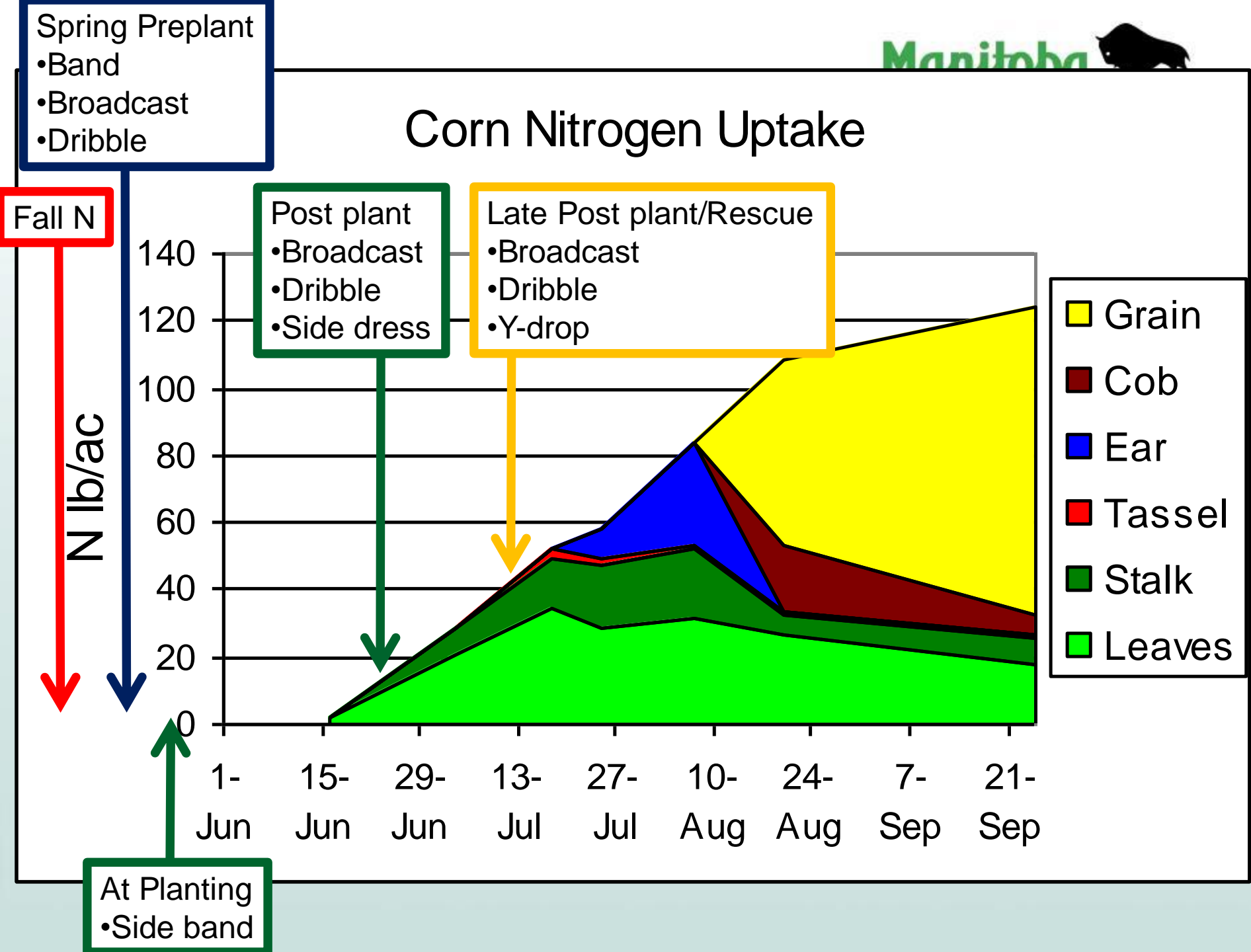
C) When do you apply N to your corn crop?

- A. Fall banded, broadcast
- B. Spring – preplant before seeding
- C. At seeding
- D. In season application
- E. Combination

Corn Nitrogen Uptake



Corn Nitrogen Uptake



Nitrogen Placement



Fertilizer Placement in Corn

% acres, E Canada

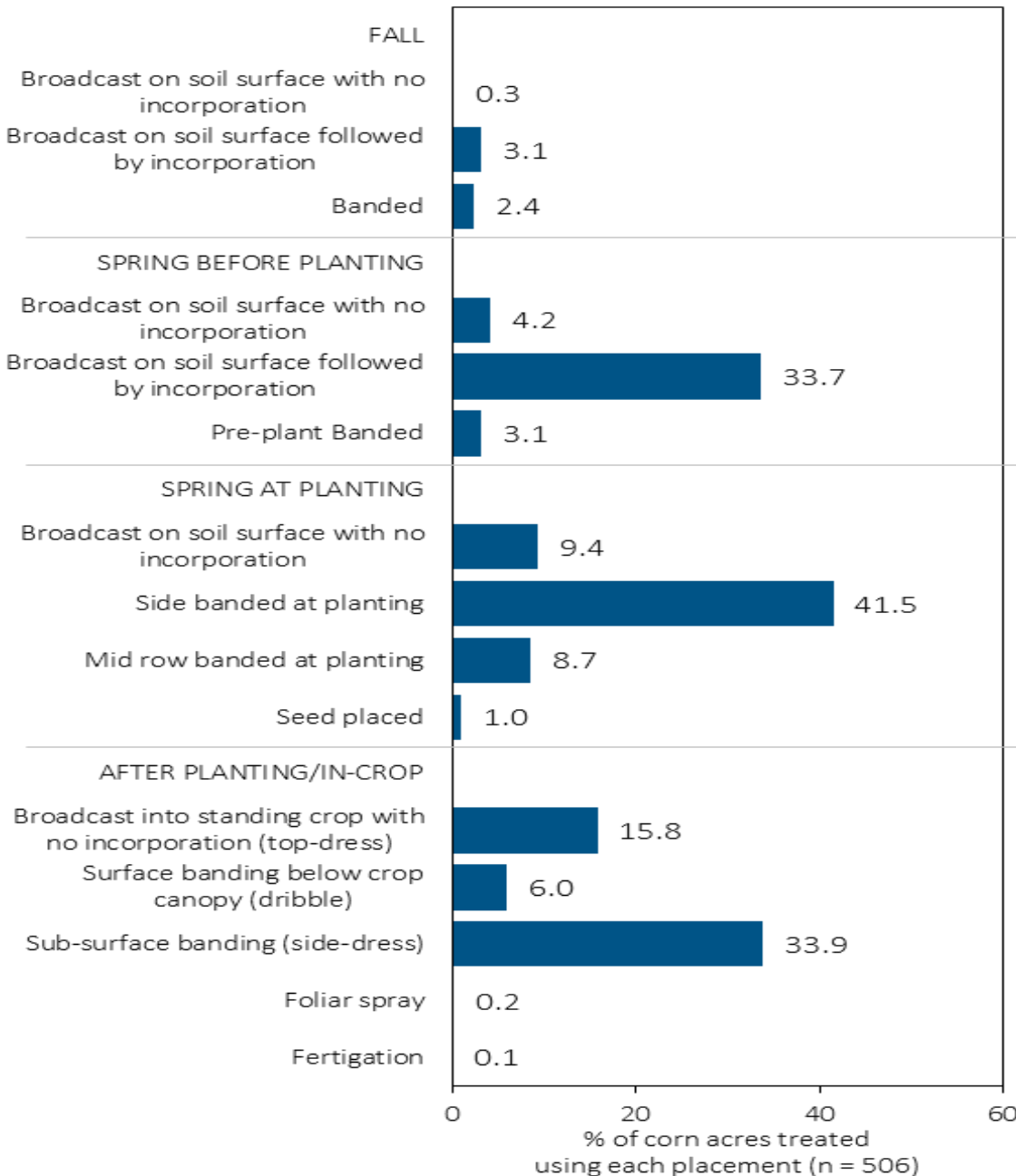
No single RIGHT way.

Most popular:

1. Sidebanded at seeding
2. Sub-surface side dressed
3. Spring Broadcast/incorp
4. Topdressed broadcast

7. Y drop

WRONG way in E Canada
Fall apps <3%

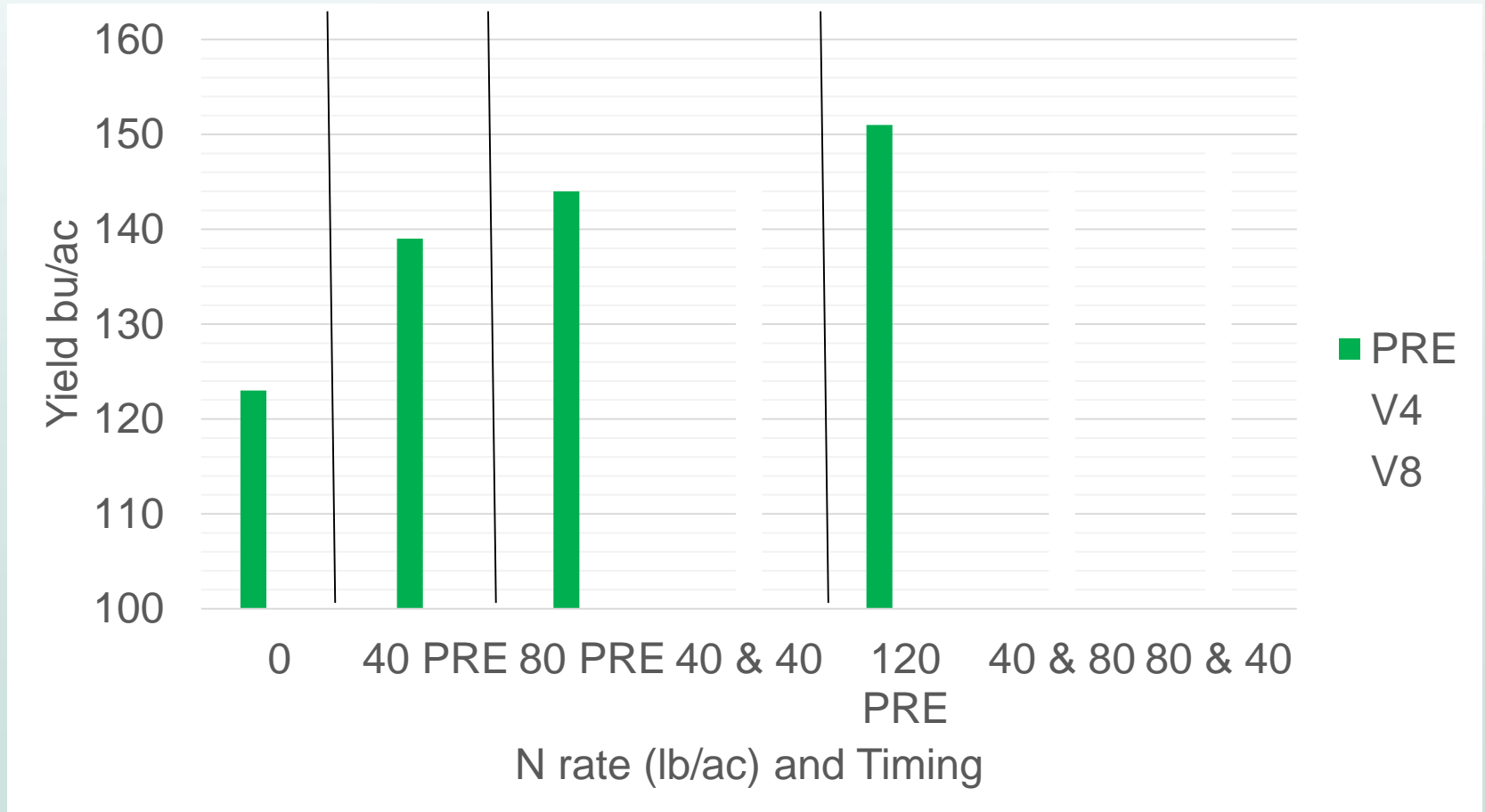


Y-drop applicator for UAN

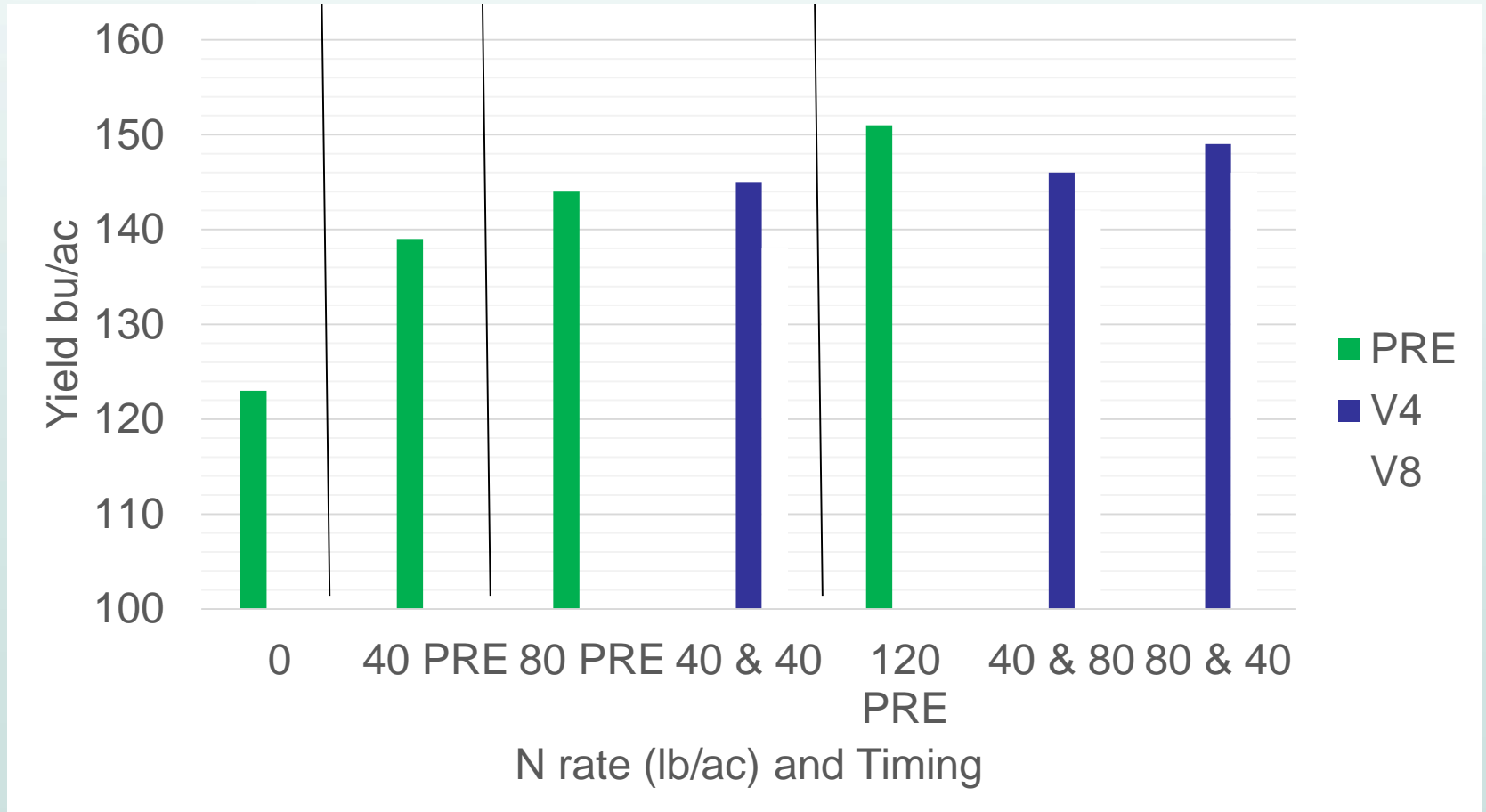
**Will it work
in MB?
Inquiring
minds want
to know.**



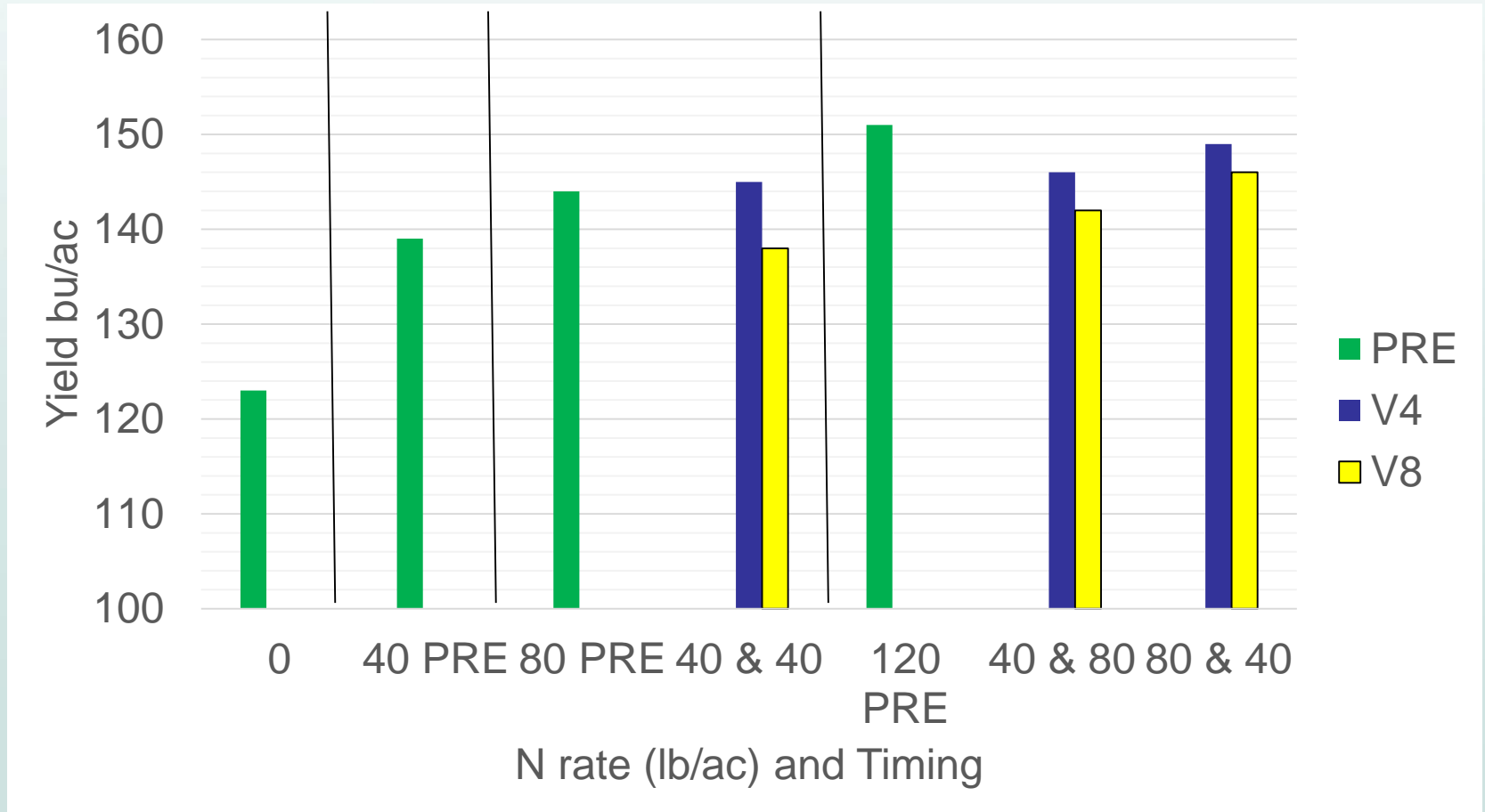
2017 N Timing in Corn



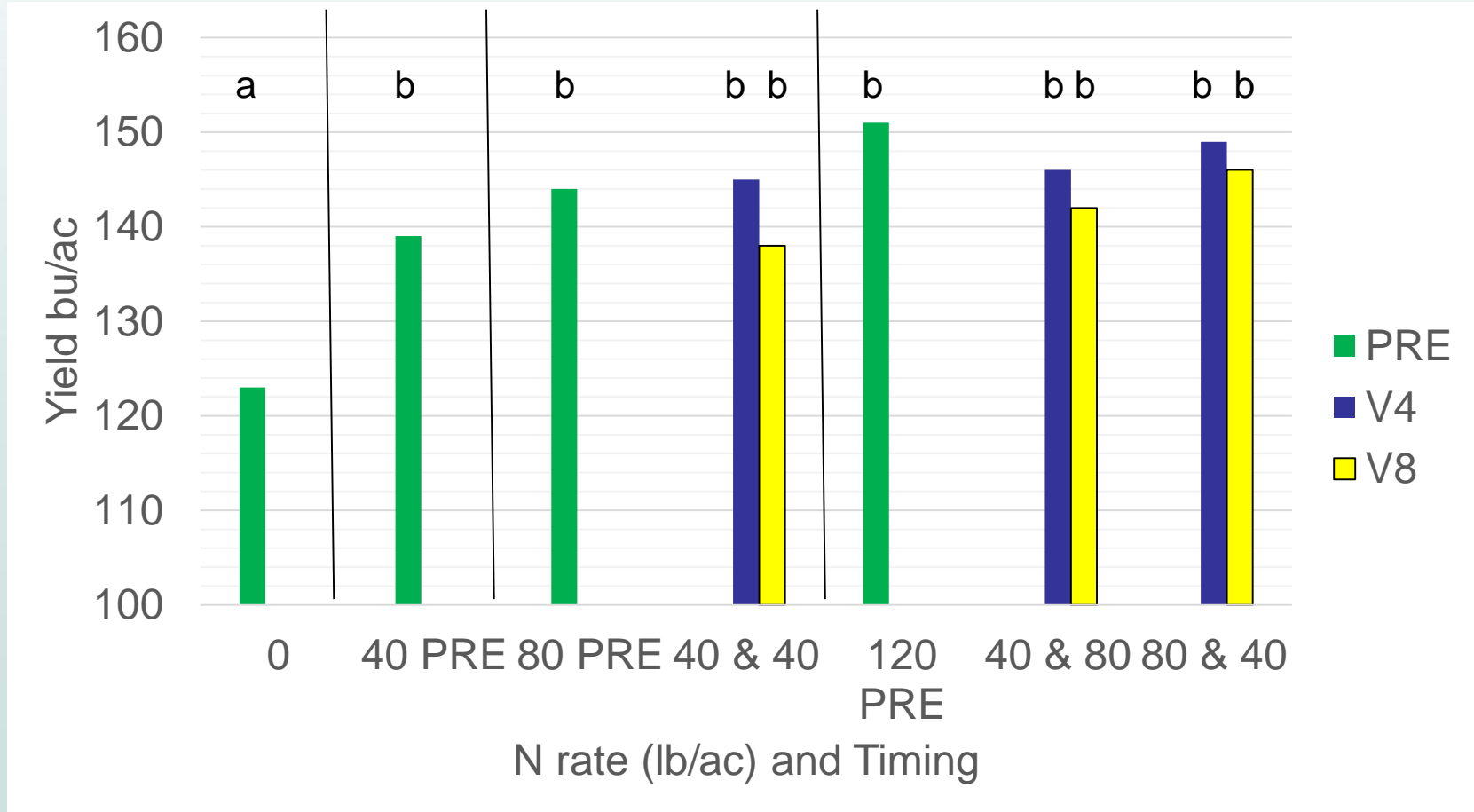
2017 N Timing in Corn



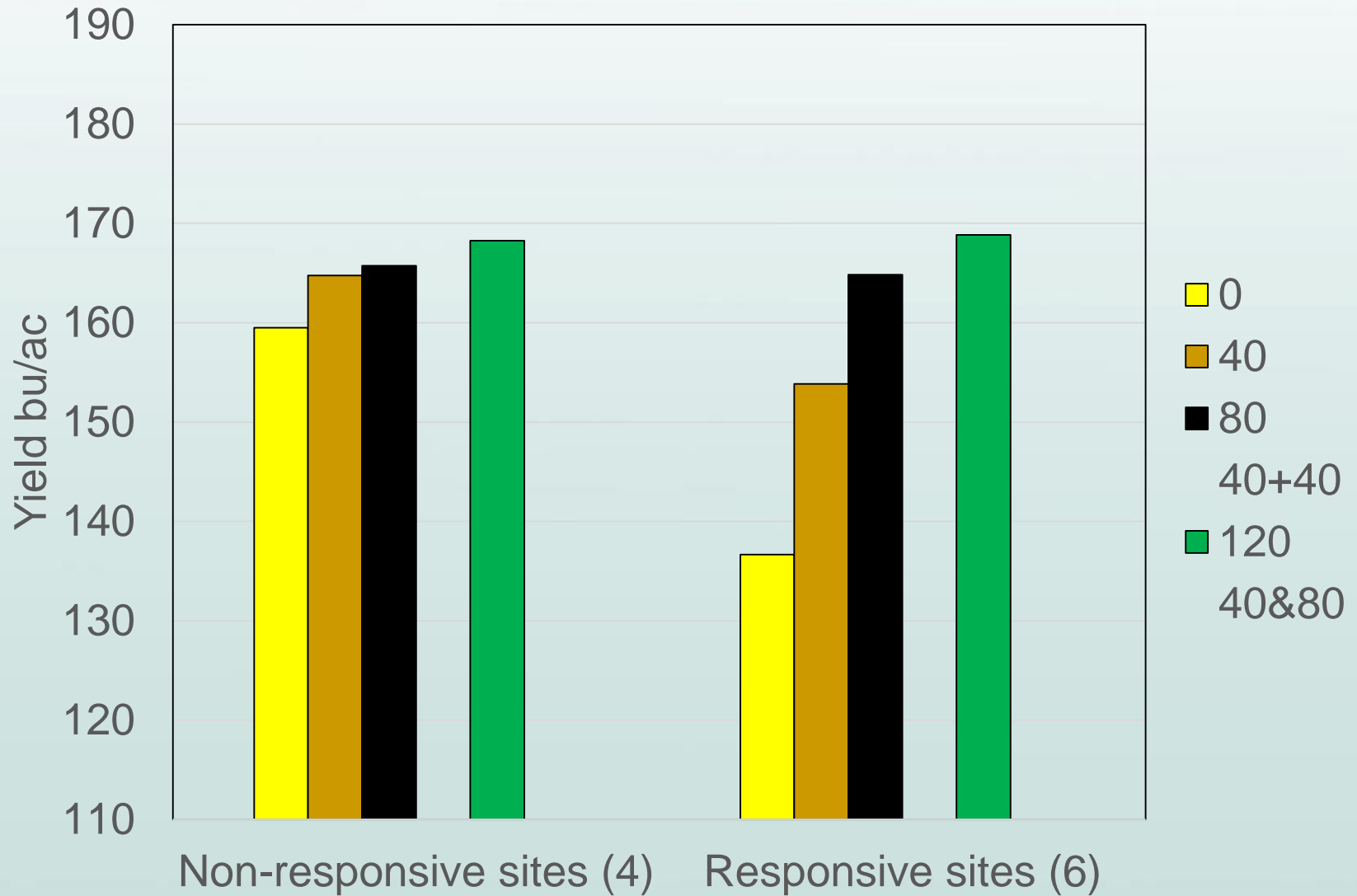
2017 N Timing in Corn



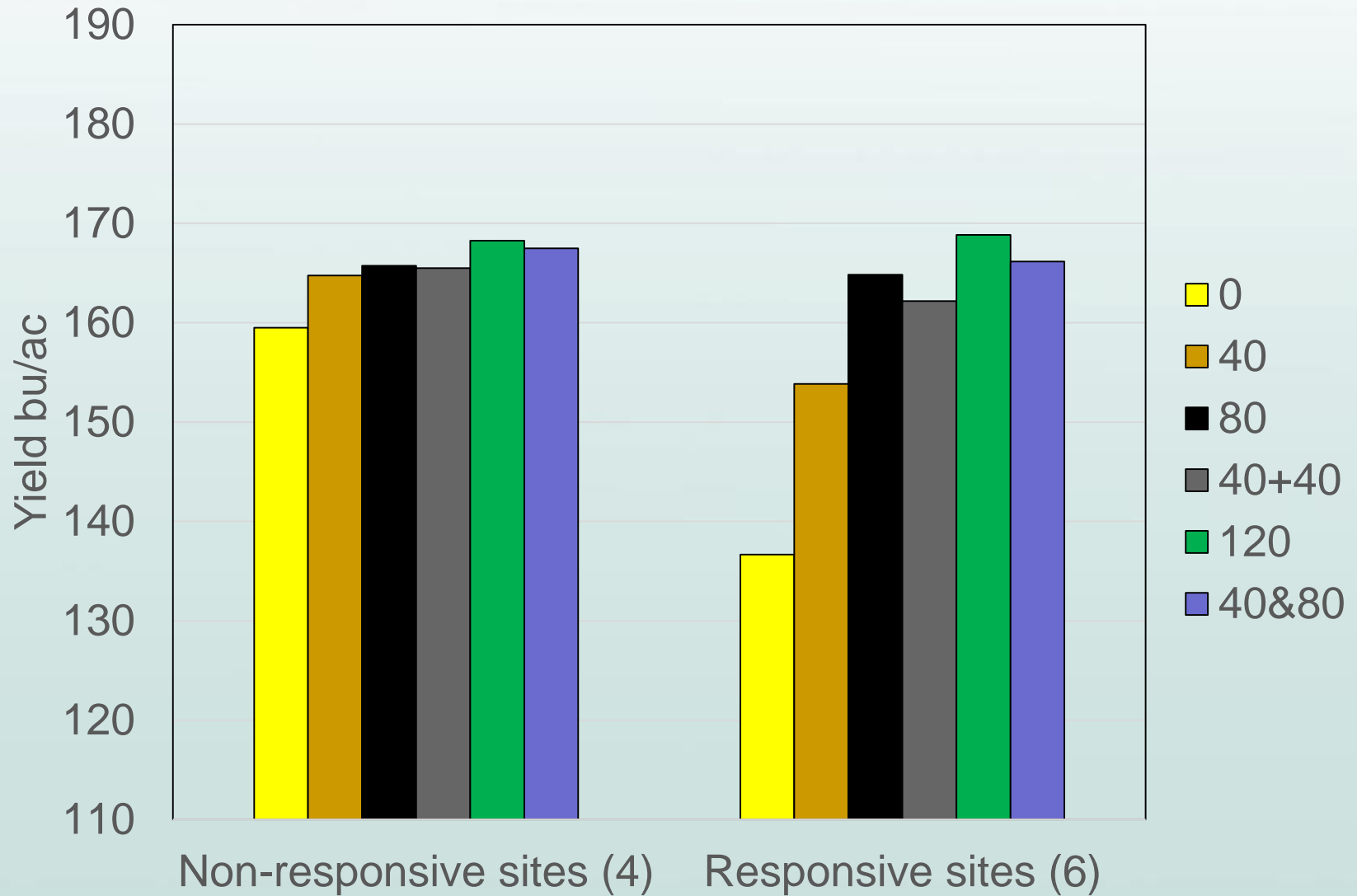
2017 N Timing in Corn (5 combined sites)



2 year summary




2 year summary



D) Timing – when does your neighbour spray weeds out of their corn?

- A. Preplant /pre-emergence control
- B. Early post emergent – weeds <2”
- C. Mid post – weeds 4” high
- D. Late post – weeds 12” high

- 
- Growers should not delay herbicide applications
 - Higher N rates are a costly substitute for untimely weed control



June 13, 2007 – 12 inch spray date



Preemerge



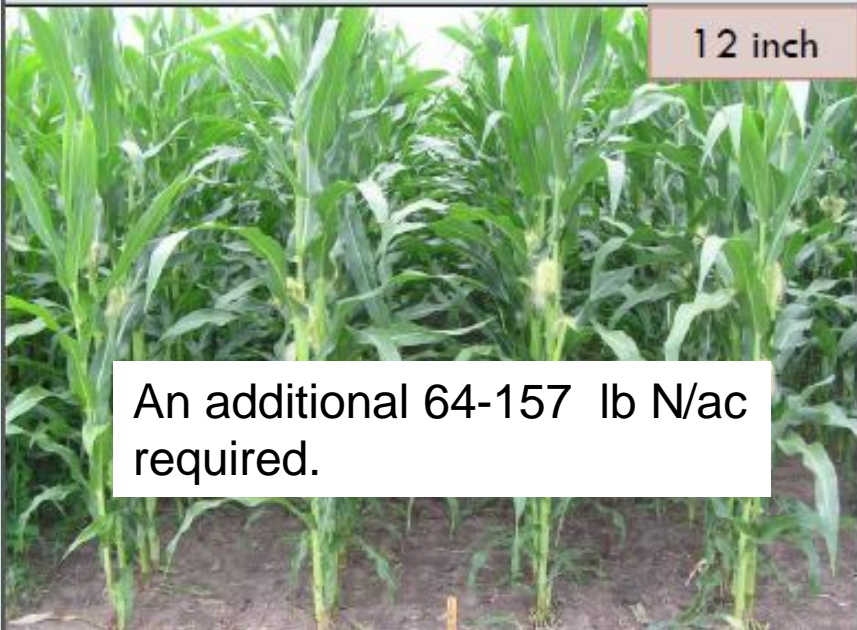
4 inch



An additional 20-61 lb N/ac required.

Mid July 2007

12 inch



An additional 64-157 lb N/ac required.

None



No amount of N can produce equal yields

Summary

- 4R combinations to manage nitrogen

1) Rates:

- average: 150-180 lb N/ac – soil N
- mineralizable N is HUGE. Need to get a handle.

2) Sources/EEF available to minimize losses

3) Timing/placement – to manage losses and exploit mineralization

More N Guidelines Under Development

- UM studies – recruiting farm sites
- AAFC studies
- MCGA on-farm-tests – recruiting cooperators

Last year – evaluated :

- Base N vs (Base N-40N) + 40N in-season

Corn N studies



	U of MB	On-Farm-Tests
Rate	0	
	40	
	80	
	120	2017
	160	
	200	
Splits V4	40 & 40	
	40 & 80	
	80 & 40	2017
Splits V8	40 & 40	
	40 & 80	
	80 & 40	

MCGA 2018 OFT

- If RATE is the question:

3 treatments:

- Base N rate
- Base N - 30
- Base N &30

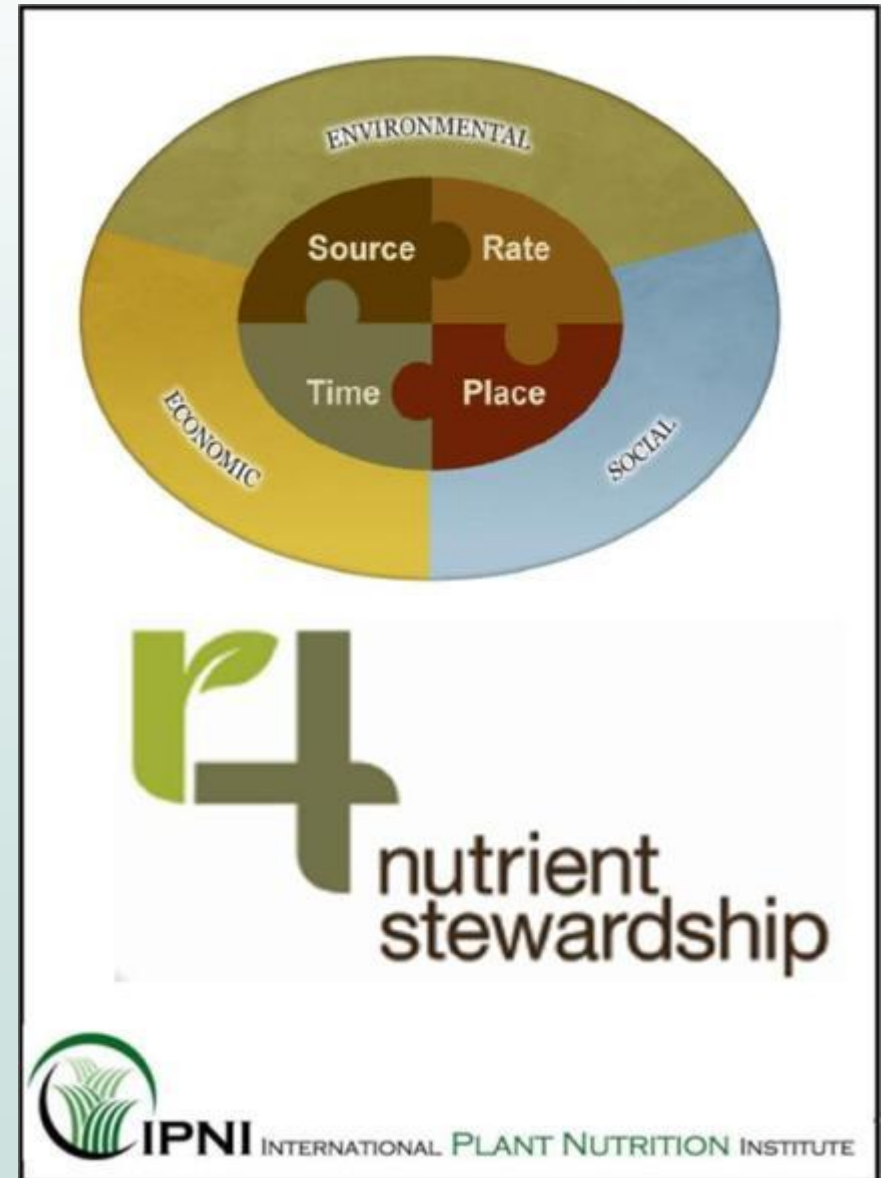
1. If within 5 bu/ac, your decision tool works
2. If no yield increase with &30 or decrease with -30 = tool failure, over applying
3. If yield increase with &30 = tool failure, under applying

E) Suggested MCGA OFT for 2018?

- A. N Rates
- B. N Sources – Enhanced efficiency products
- C. In-season N Timing and Placement
- D. Corn P starter

4R Nutrient Stewardship

- ✓ Right rates
- ✓ Right sources
- ✓ Right placement
- ✓ Right timing



Corn project sponsors

- AgVise Laboratories
- KOCH Fertilizers

