Consider Your Options: Making In-Season Nitrogen Applications

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University of Minnesota
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Nitrogen Management 101

- **N is expensive: can't afford to over apply**
- **Corn needs N: can't afford to under apply**
- **N can create environmental degradation**
  - **Under the current regulatory climate N is being heavily scrutinized**
  - **Ensure that this nutrient is being used very wisely**

Nitrogen Management Made Easy

Apply just what the crop needs, at the best possible time using the proper application method for the nitrogen source being used

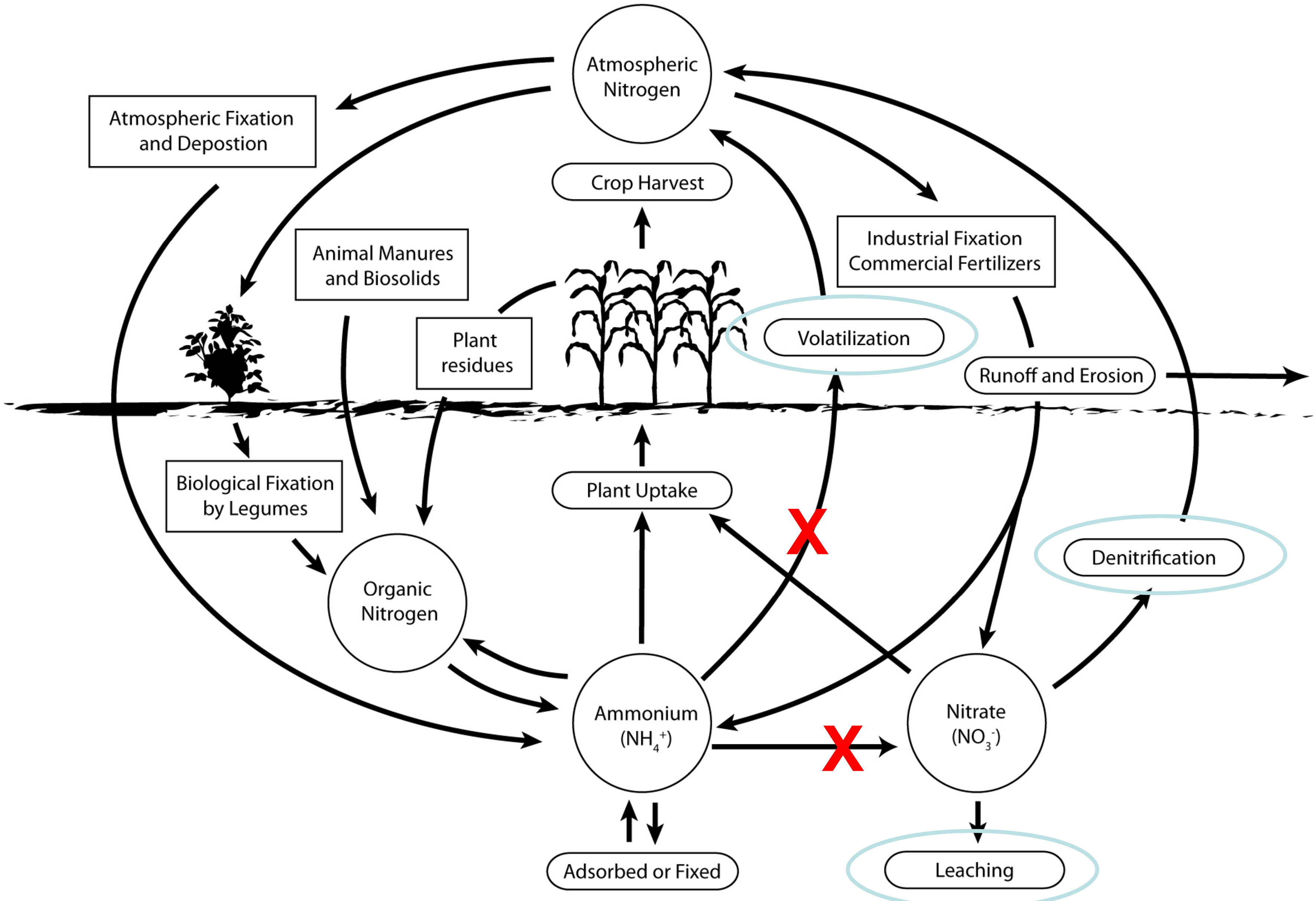
<u>Two principles</u>

- **Enhance nitrogen uptake**
- **Minimize nitrogen loss**

Nitrogen Management is Not Just Pounds of N per Acre

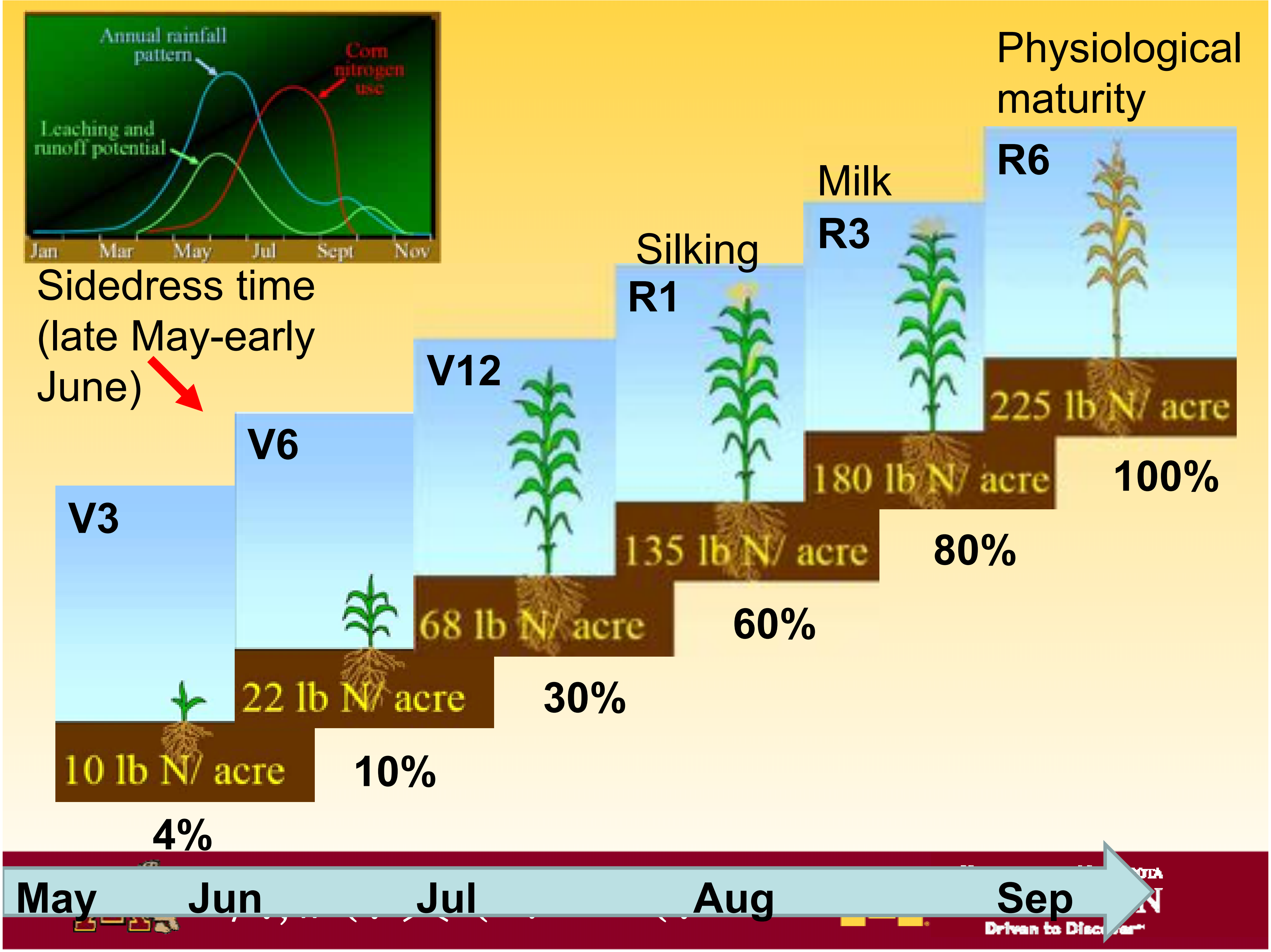
- Often discussions on nitrogen management revolve only around the topic of rate of application
  - 1) Adequate availability to the crop
  - 2) Minimize the amount of leftover nitrogen at the end of the season
- Other variables are also important
  - Source, time, application method, prevailing weather conditions, region/soil of the state

The Nitrogen Cycle



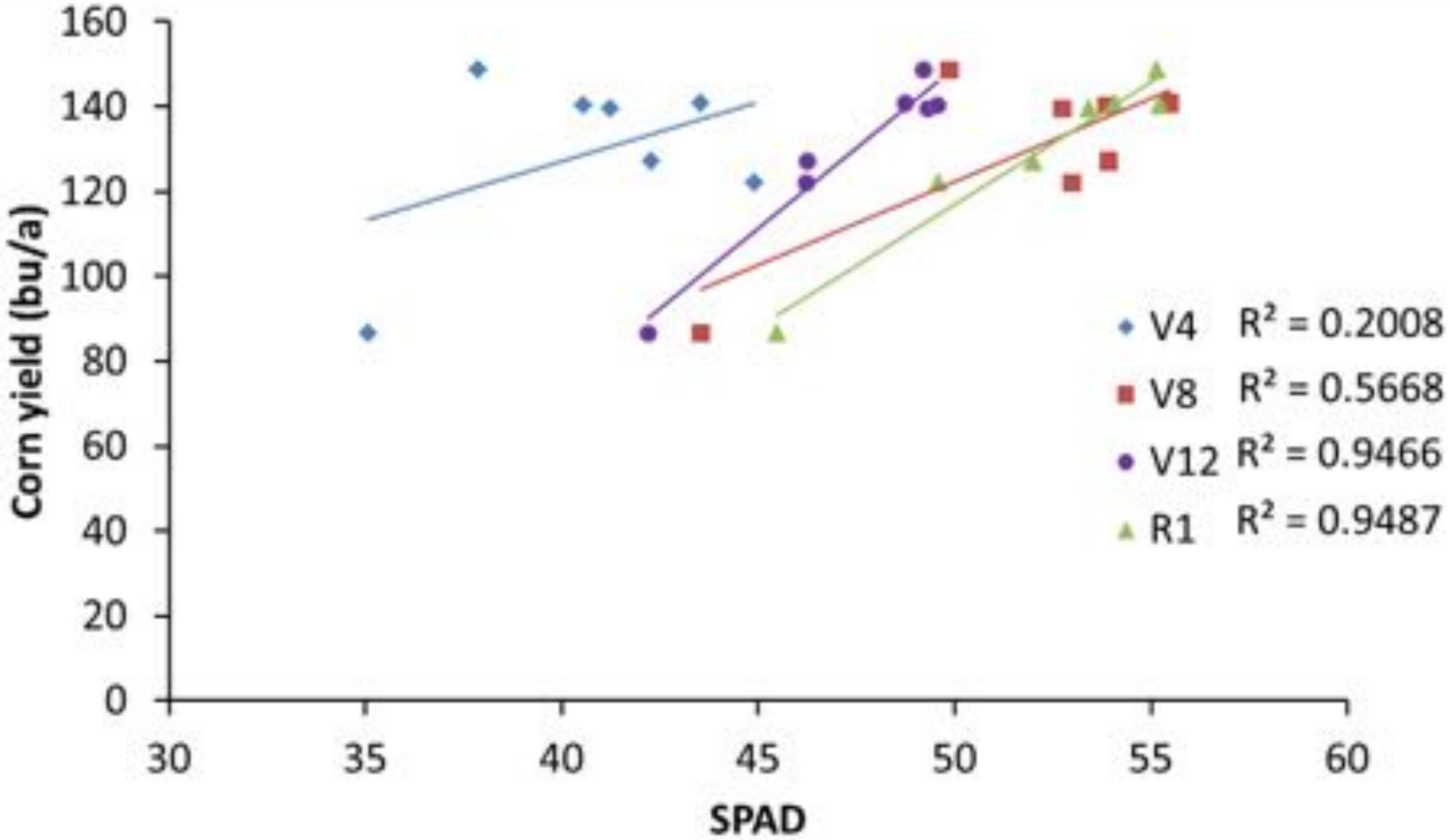
71% of annual subsurface drainage during Apr-Jun.

How Dinosaurs Became Extinct


Annual rainfall pattern
Corn nitrogen use
Leaching and runoff potential
Jan
Mar
May
Jul
Sept
Nov
Sidedress time (late May-early June)
Physiological maturity
R6
Milk
R3
Silking
R1
V12
V6
V3
10 lb N/ acre
22 lb N/ acre
68 lb N/ acre
135 lb N/ acre
180 lb N/ acre
225 lb N/ acre
4%
10%
30%
60%
80%
100%
May
Jun
Jul
Aug
Sep

Can We Use Crop Sensors To Improve N Management?

Lamberton, C-C



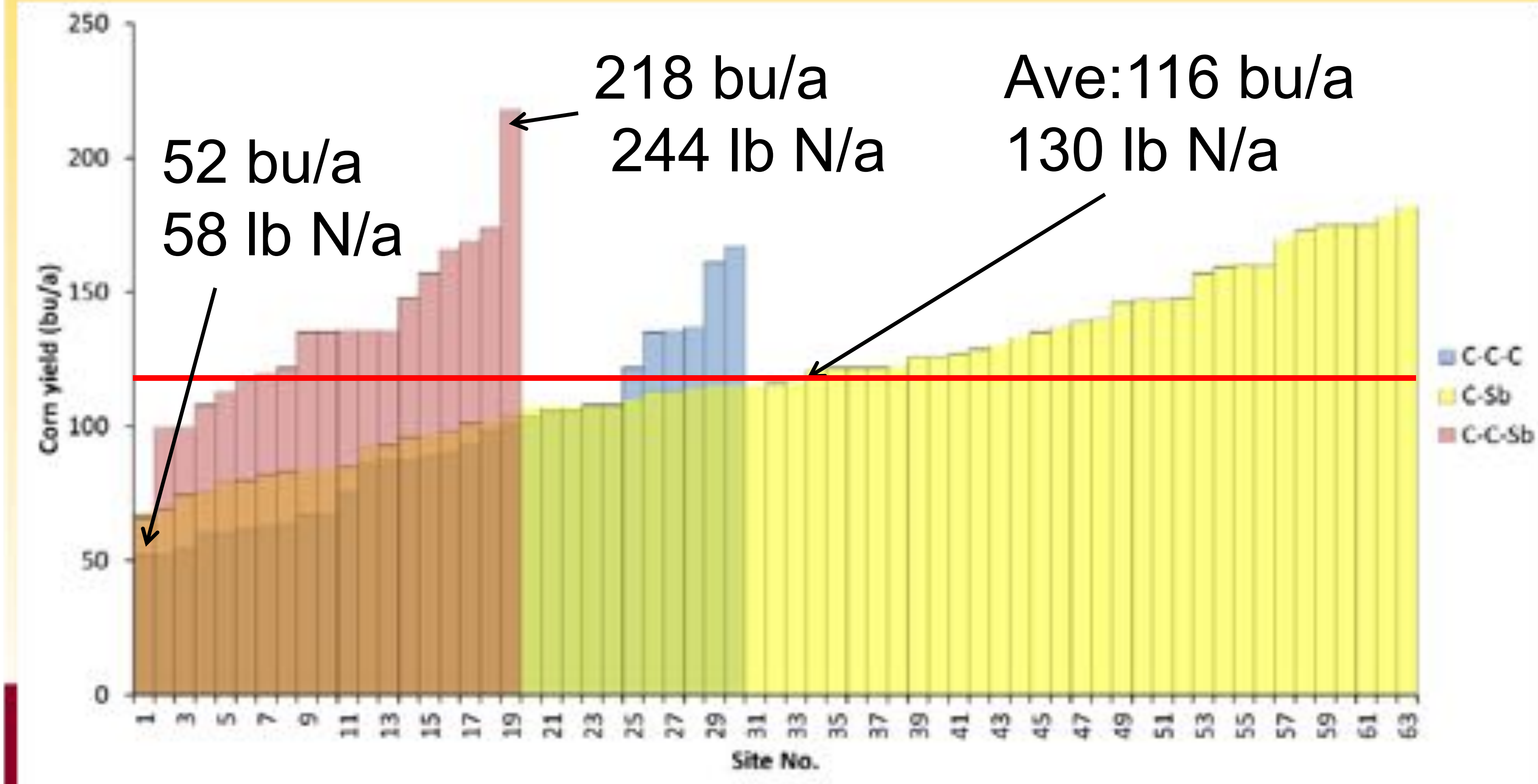
Using Canopy Sensors

- The earlier the sensing the greater the flexibility to apply nitrogen, BUT
- The earlier the sensing the lesser the predictive power
- The later the sensing the greater the predictive power, BUT
- The later the sensing the lesser the flexibility to apply nitrogen and greater potential for yield loss

How Much N is Naturally in the Soil and Available to Crops?

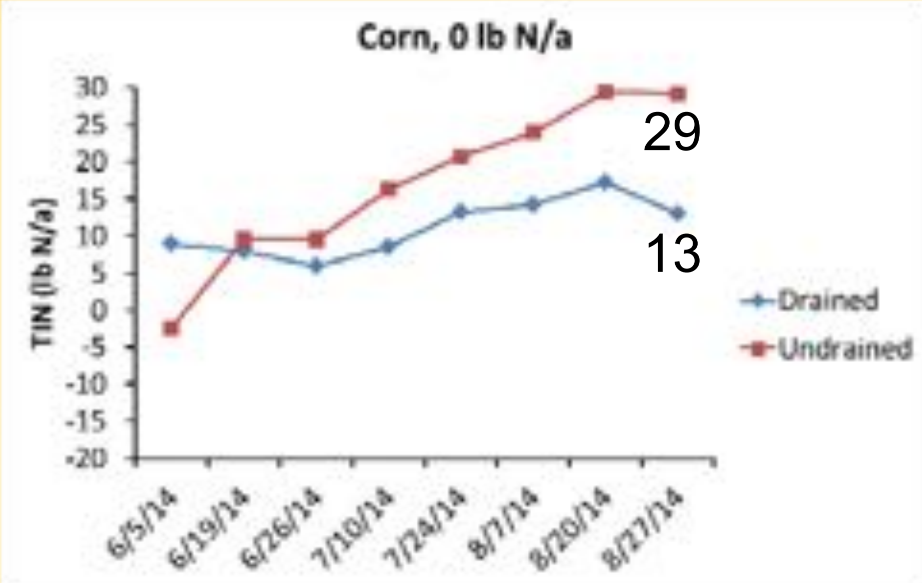
- About 5% of OM is N
- Each 1% OM in top 7 inches = 20,000 lb OM/acre
- Annually, about 1 to 3% of the organic N converts into plant-available N
- Soil with 4% OM = 4,000 lb organic N
  - 40 to 120 lb of N per acre per year
- Deeper soils can provide more

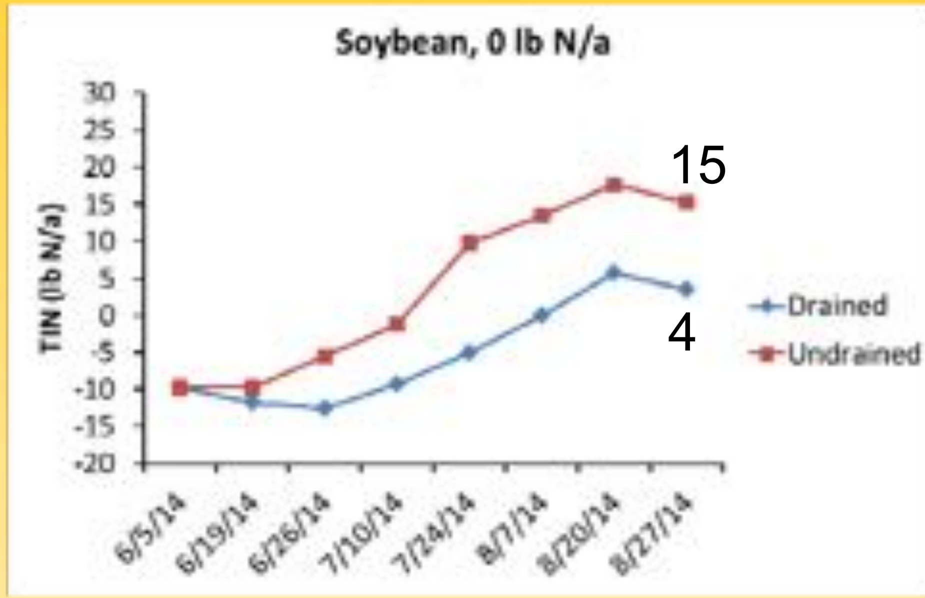
How Much Yield Can We Get Through Mineralization in High and Very High Yield Potential Soils?

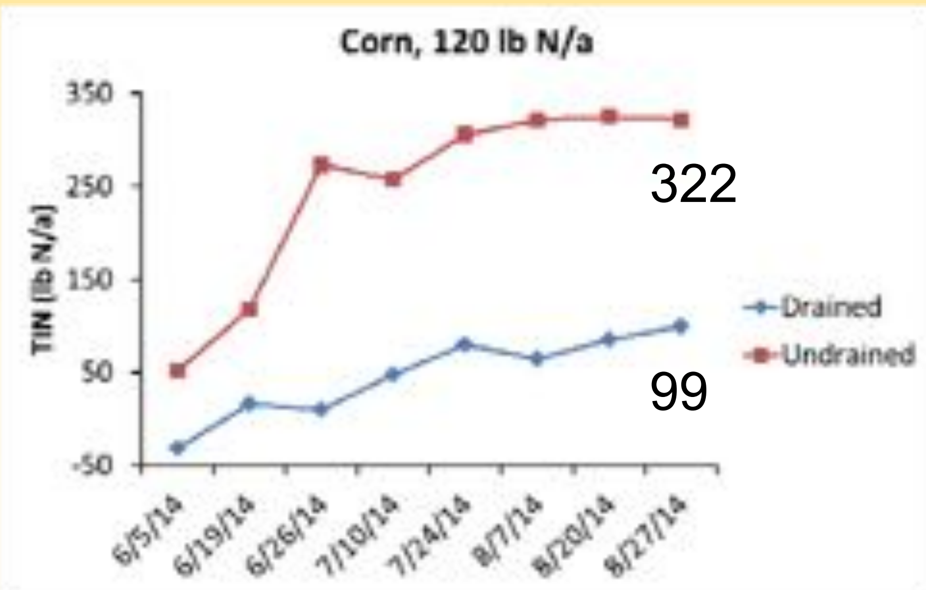


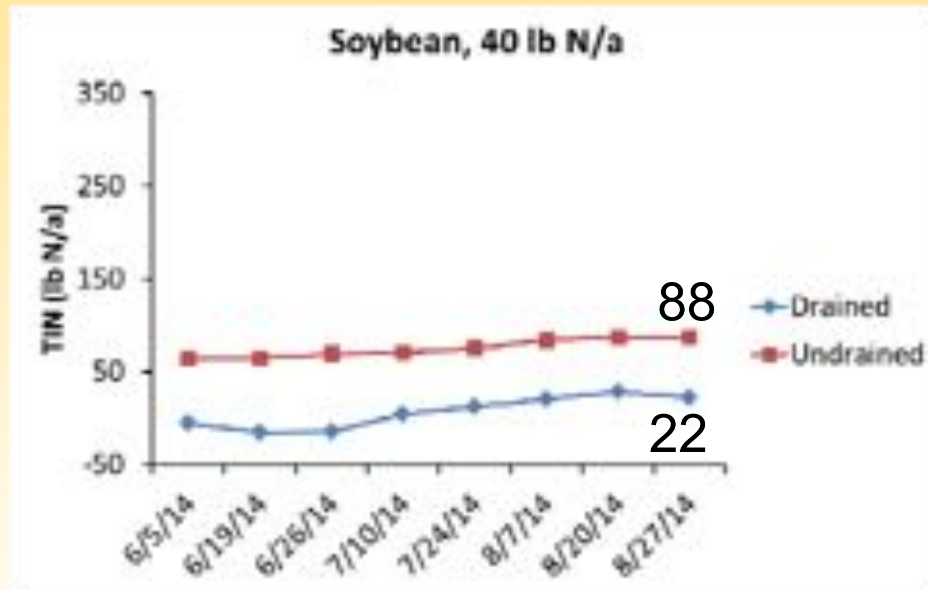
Percent of Corn Yield at EONR Obtained from the 0-N Check

State	Corn-corn	Corn-soybean
	-----------% of optimum----------	
Illinois	43	59
Iowa	40	66
Michigan		59
Minnesota	53	71
Wisconsin (no sands)	55	73



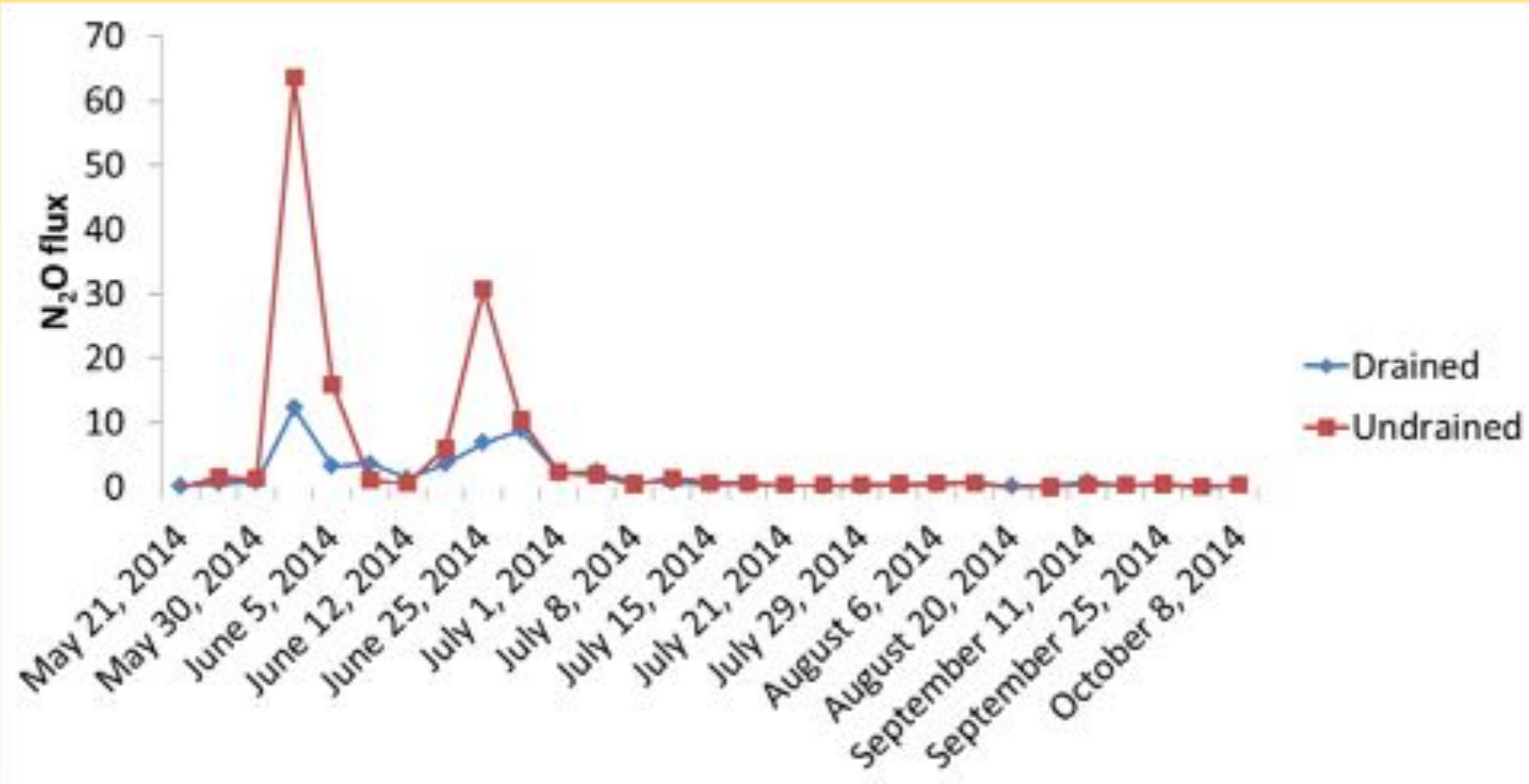




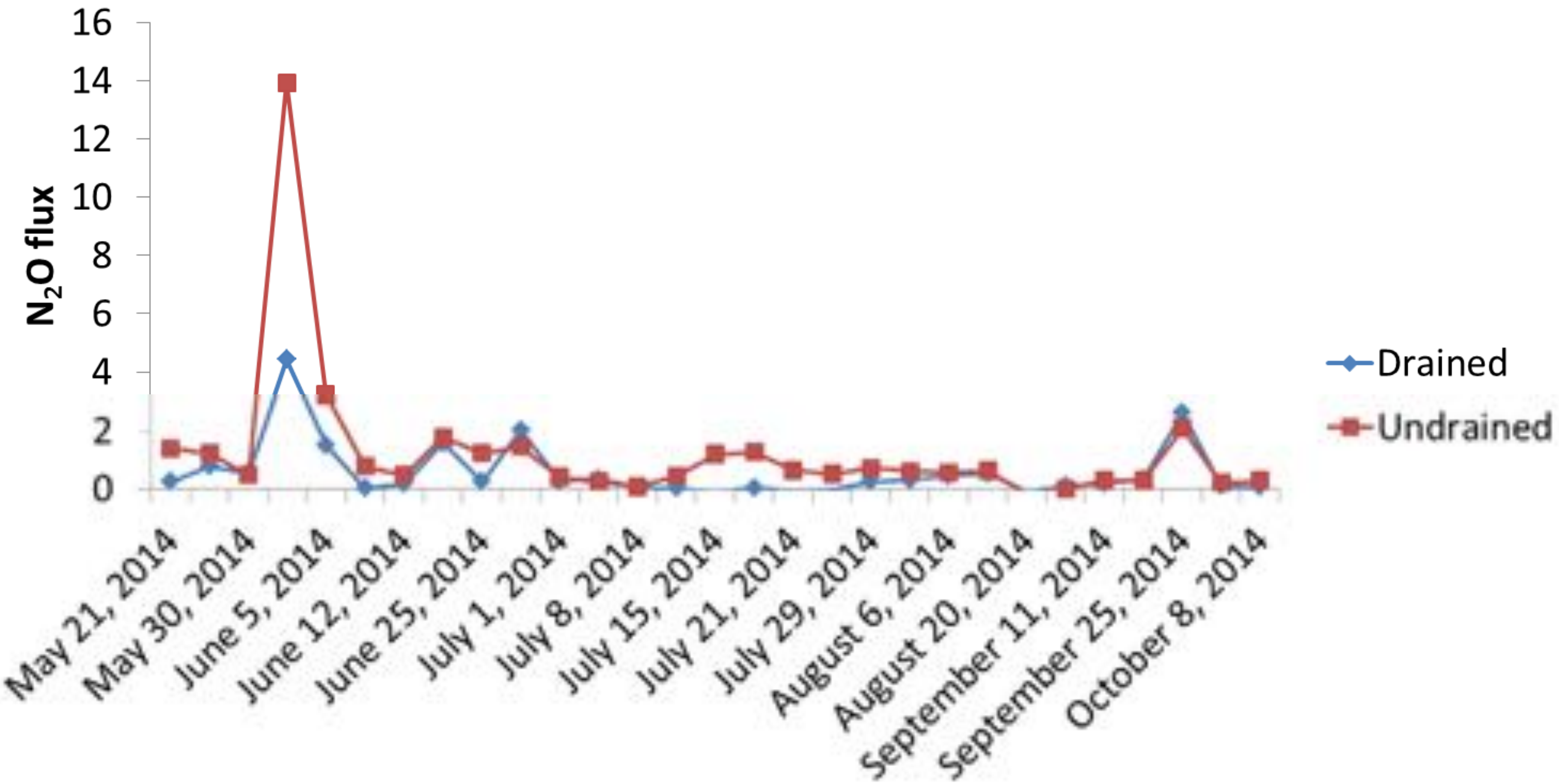


Marna silty clay loam and Nicollet silty clay loam

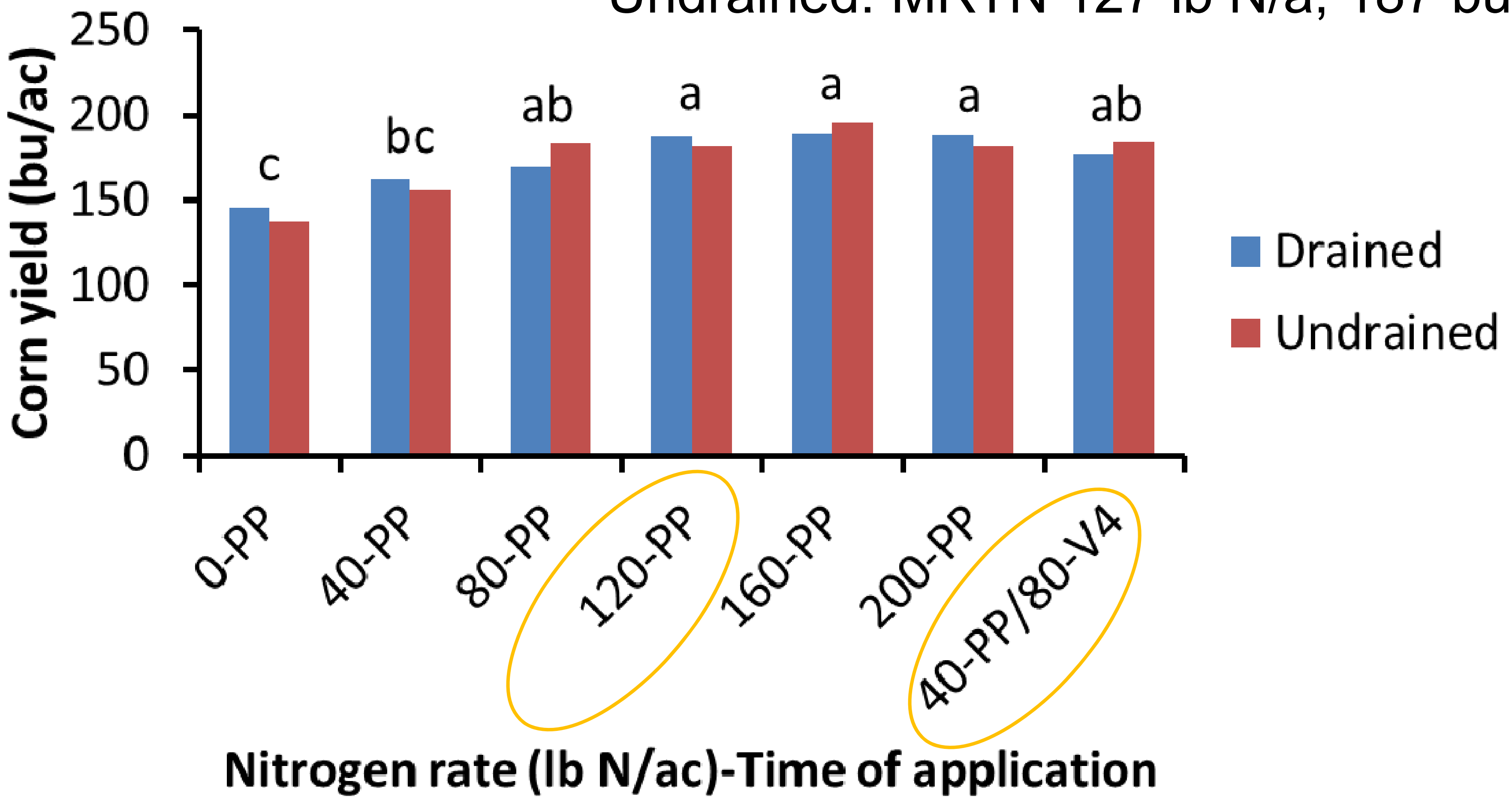
N_2O emissions, Corn



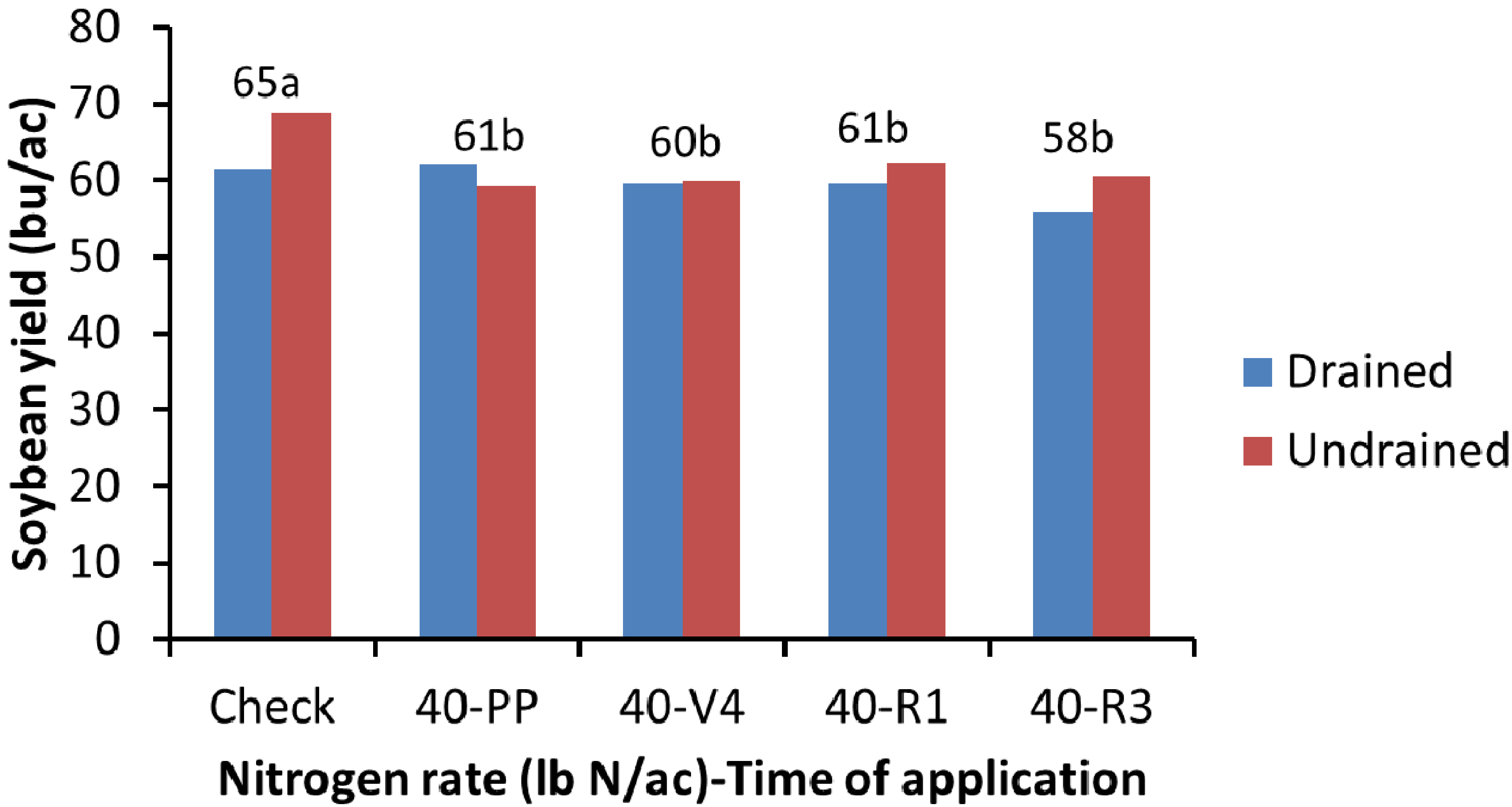
N_2O emissions, Soybean



Drained: MRTN 148 lb N/a, 187 bu/a
Undrained: MRTN 127 lb N/a, 187 bu/a

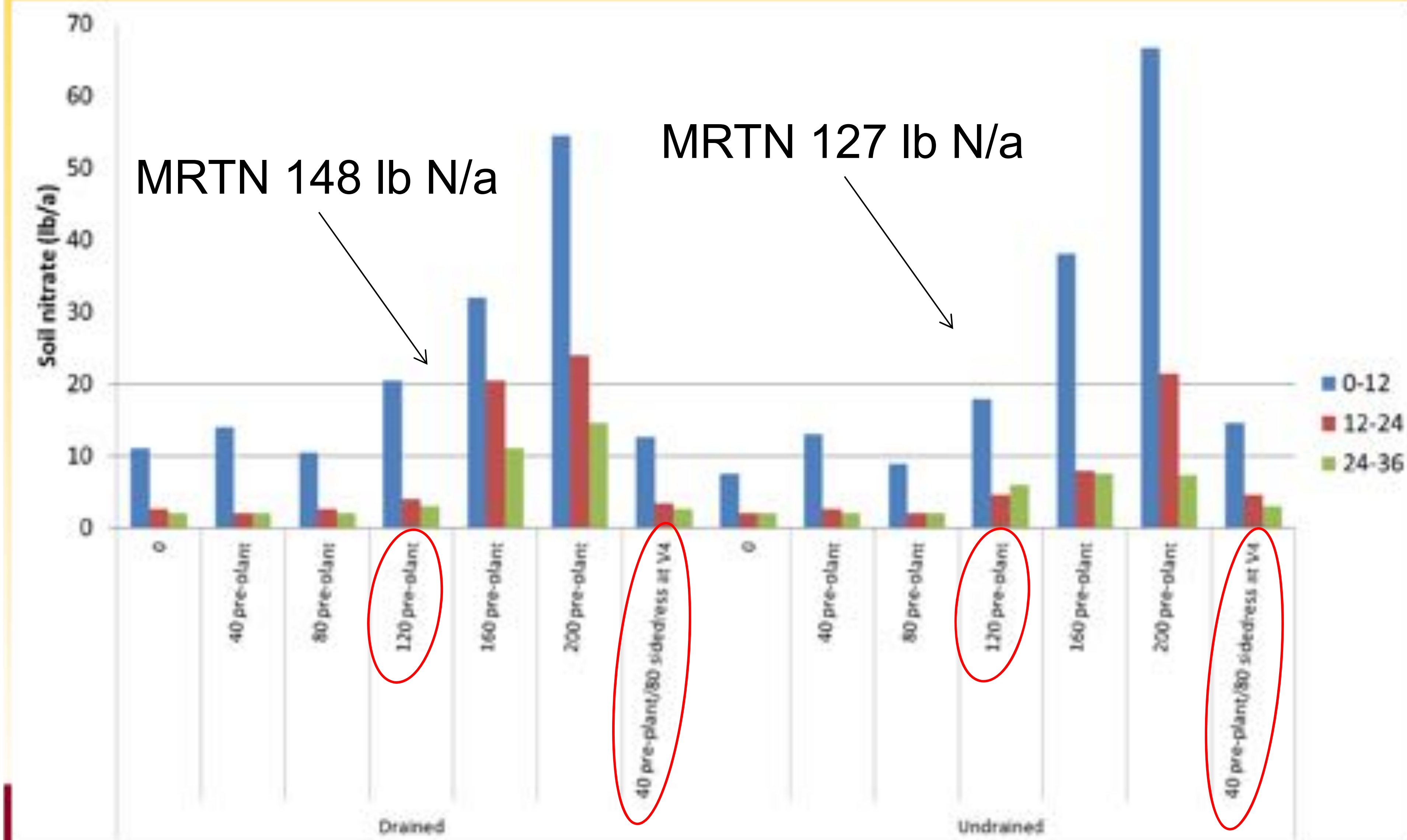


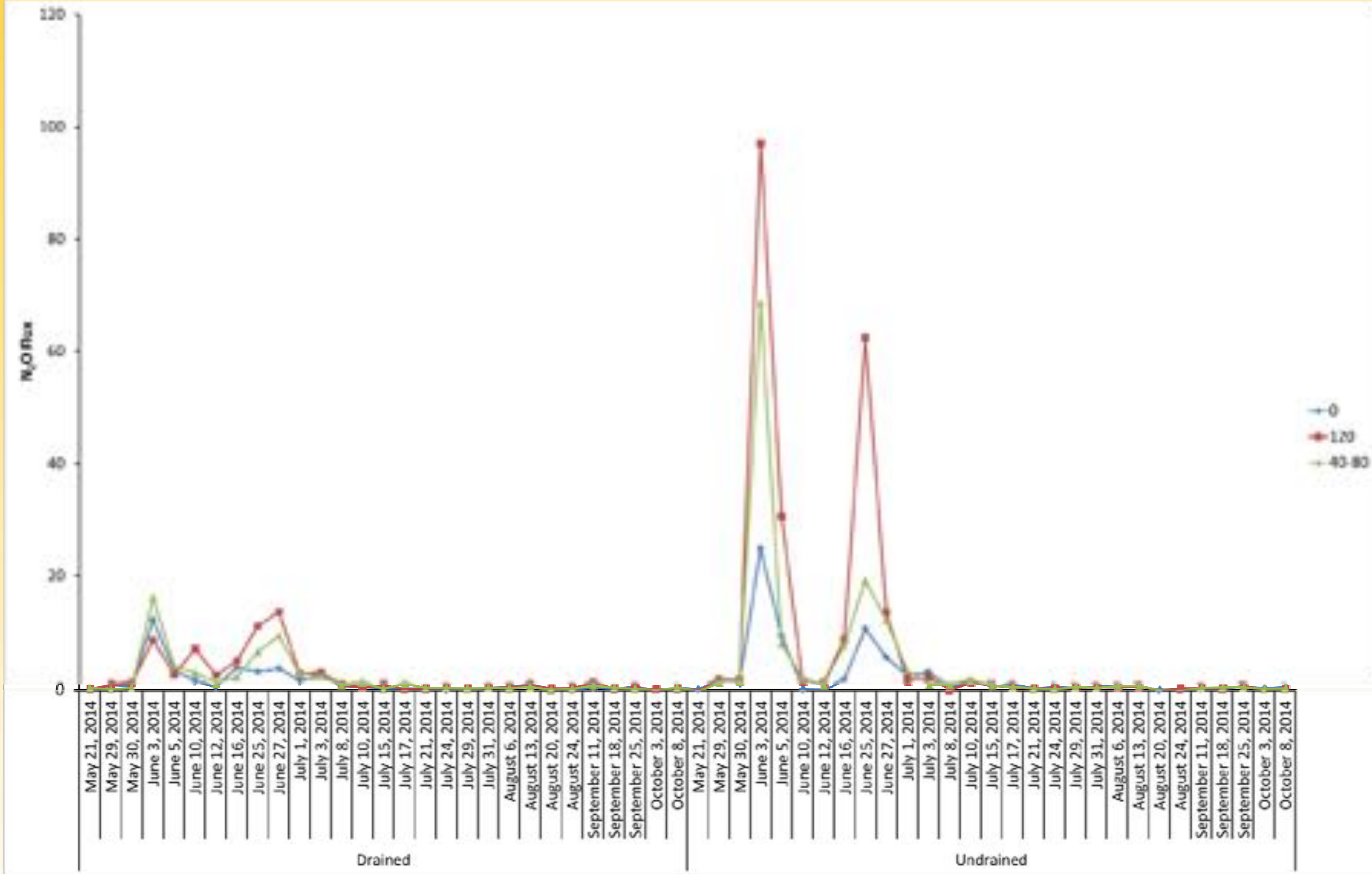
Marna silty clay loam and Nicollet silty clay loam

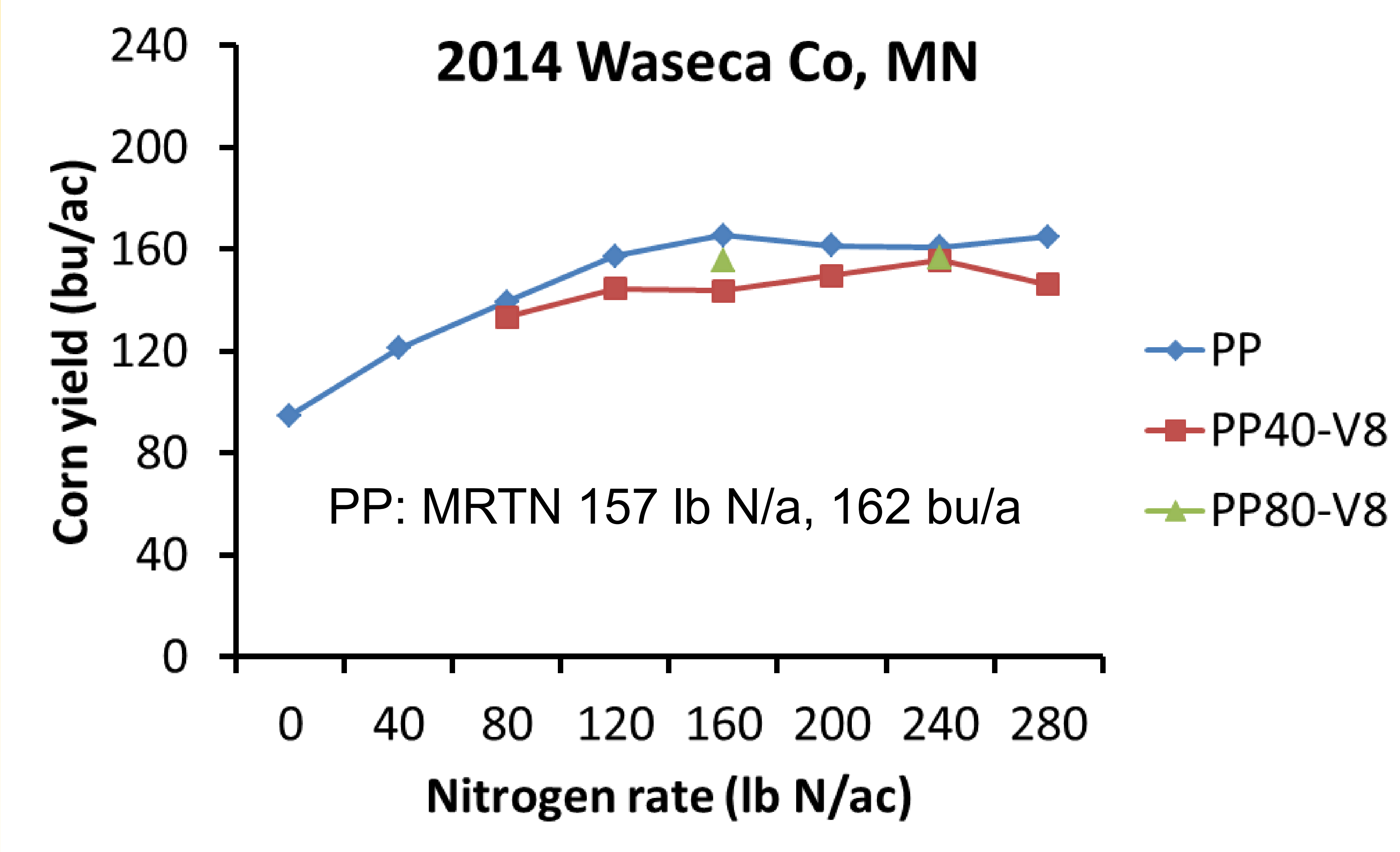


Marna silty clay loam and Nicollet silty clay loam

End of Season Nitrate, Corn Plots




120
100
80
60
40
20
0
N₂O flux
0
120
40-80
May 21, 2014 · May 29, 2014 · May 30, 2014 · June 3, 2014 · June 5, 2014 · June 10, 2014 · June 12, 2014 · June 16, 2014 · June 25, 2014 · June 27, 2014 · July 1, 2014 · July 3, 2014 · July 8, 2014 · July 10, 2014 · July 15, 2014 · July 17, 2014 · July 21, 2014 · July 24, 2014 · July 29, 2014 · July 31, 2014 · August 6, 2014 · August 13, 2014 · August 20, 2014 · August 24, 2014 · September 11, 2014 · September 18, 2014 · September 25, 2014 · October 3, 2014 · October 8, 2014
Drained
May 21, 2014 · May 29, 2014 · May 30, 2014 · June 3, 2014 · June 5, 2014 · June 10, 2014 · June 12, 2014 · June 16, 2014 · June 25, 2014 · June 27, 2014 · July 1, 2014 · July 3, 2014 · July 8, 2014 · July 10, 2014 · July 15, 2014 · July 17, 2014 · July 21, 2014 · July 24, 2014 · July 29, 2014 · July 31, 2014 · August 6, 2014 · August 13, 2014 · August 20, 2014 · August 24, 2014 · September 11, 2014 · September 18, 2014 · September 25, 2014 · October 3, 2014 · October 8, 2014
Undrained



Canisteo-Glencoe and Webster clay loam, 0 to 2 percent slopes

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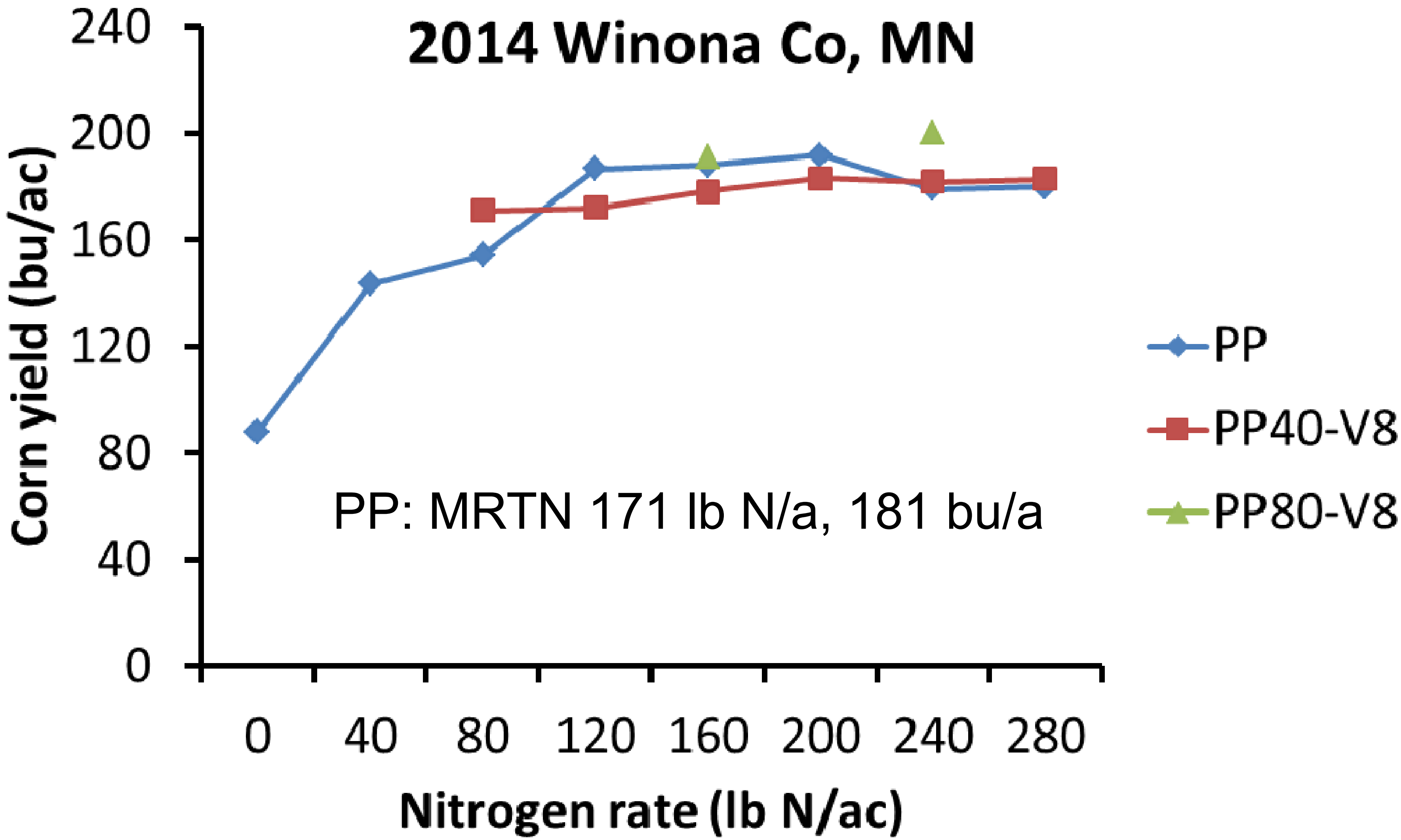


Seaton silt loam soil 3-6% slope

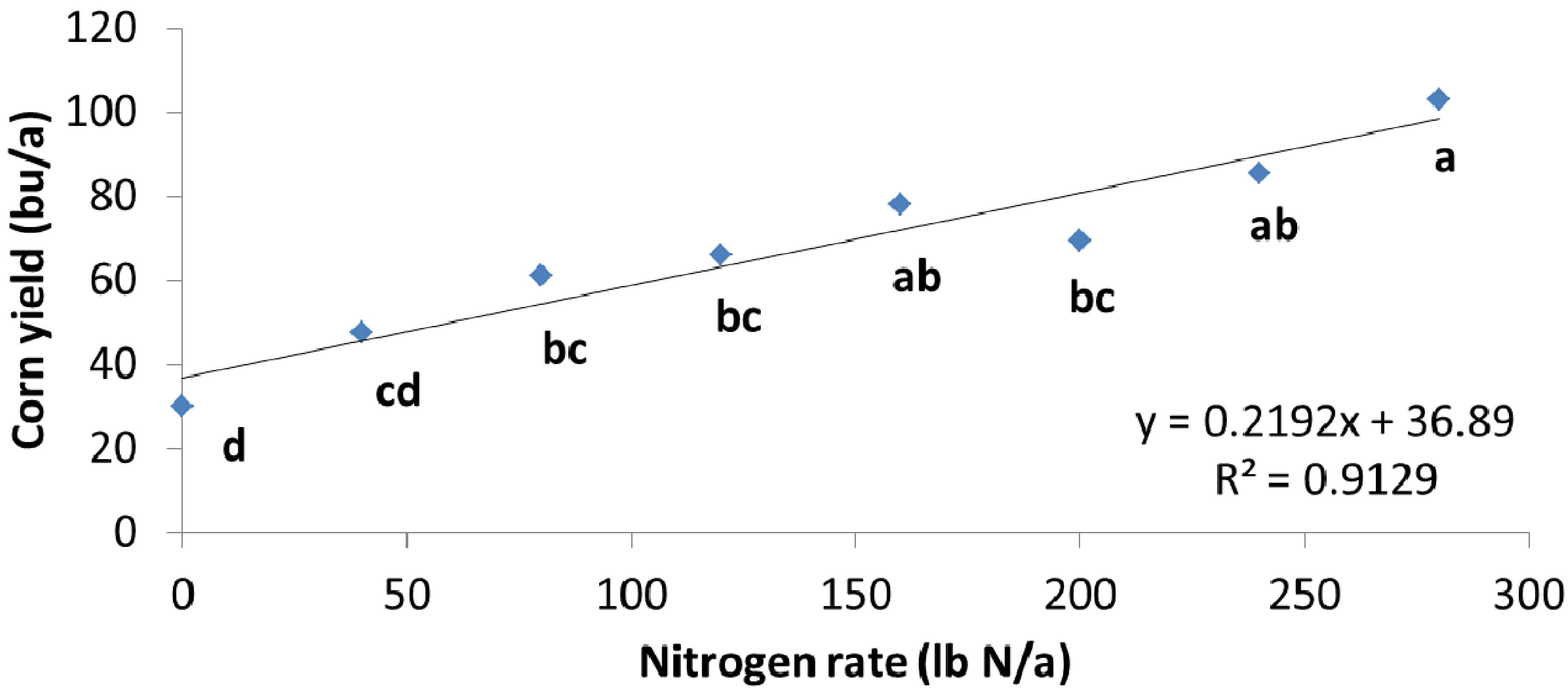
Irrigated Sandy Soil Corn

	Dakota Co. corn/corn				Pope Co. corn/corn				Pope Co. Corn/soybean			
	2011	2012	2013	2014	2011	2012	2013	2014	2011	2012	2013	2014
Trt	Corn grain yield (bu/A)											
Check	150	100	87	69	82	83	79	83	111	174	126	118
Urea BMP	238	208	216	200	180	223	186	149	194	197	187	206
Super U	223	175	223	176	172	235	162	127	187	159	202	181
ESN	222	198	214	177	172	234	178	129	179	187	202	179
ESN/Urea	220	188	211	195	172	211	164	138	169	168	200	184

Quest to Finding the Best Time for Sidedress, 2014

Location Rotation	Planting date	Lowest yield	Highest yield	Response equation	R^2
Becker C-C	5/14	30	103	$y = 0.2192x + 36.89$	0.91
Clara City C-C	5/30	53	137	$y = 0.3202x + 55.229$	0.83
SWROC C-C	5/30	86	149	$y = -0.0014x^2 + 0.5448x + 92.832$	0.92
SROC C-C	5/23	47	140	$y = 0.3781x + 51.183$	0.92
SROC C-S	5/11	71	150	$y = -0.002x^2 + 0.7963x + 70.319$	0.99
Theilman C-C	5/22	109	206	$y = -0.0033x^2 + 1.1x + 102.85$	0.82

Becker, 2014



Hubbard loamy sand

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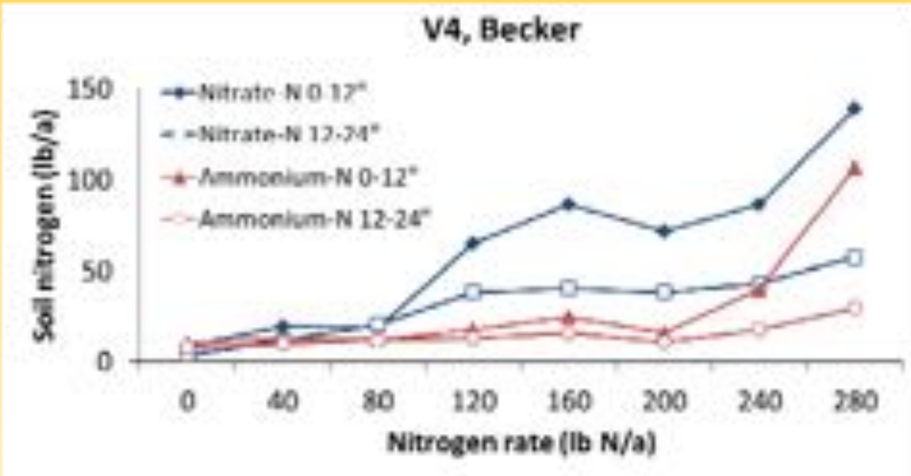
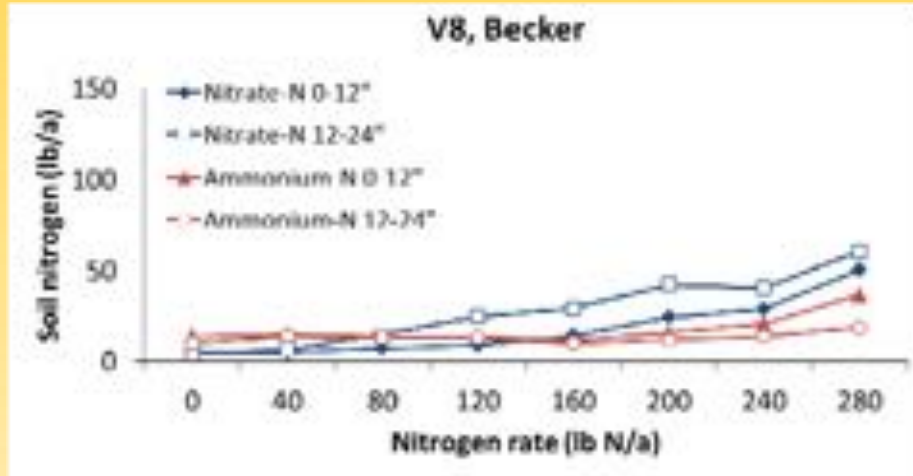
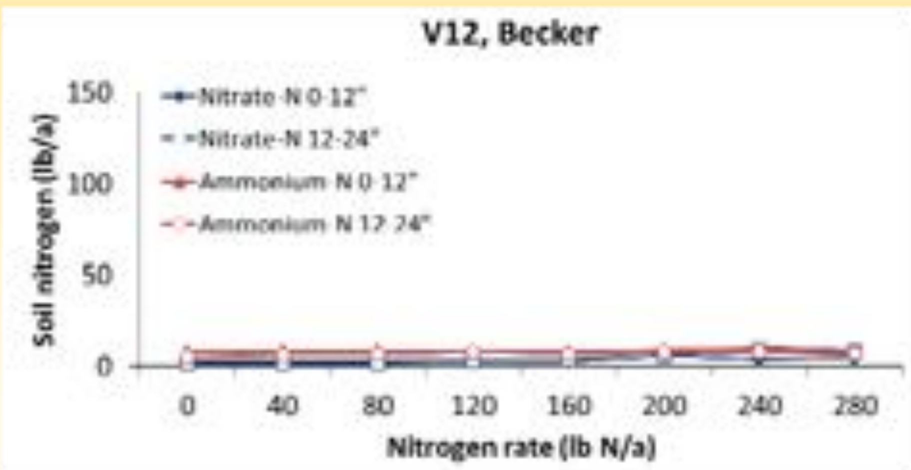
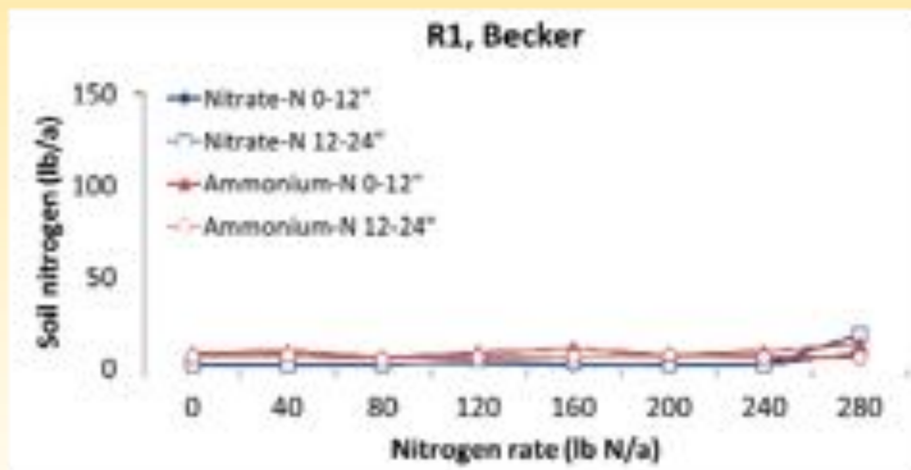
Soil N with Pre-plant Applications





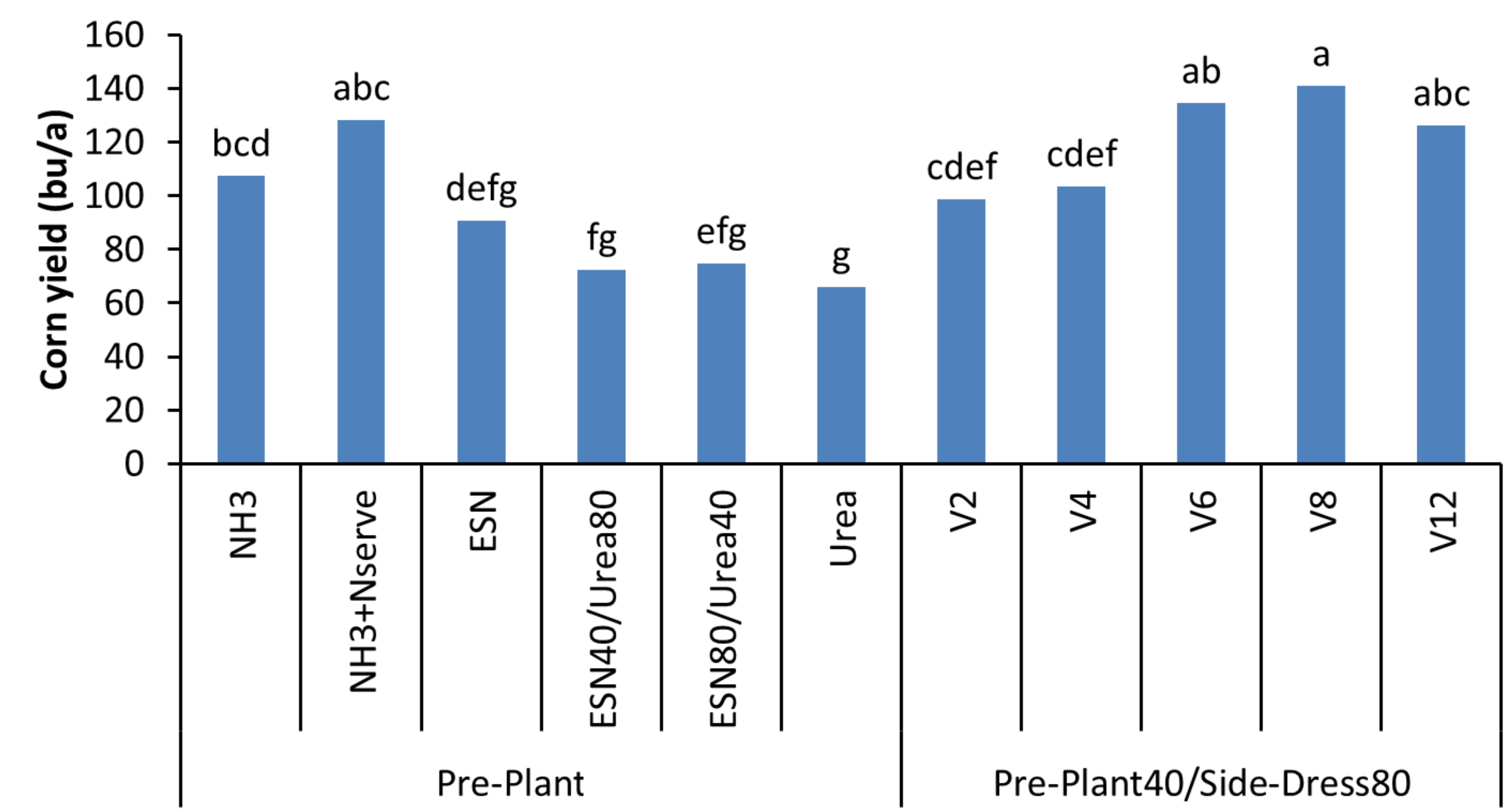
Soil with 1.6% OM, CEC 8 meq/100g



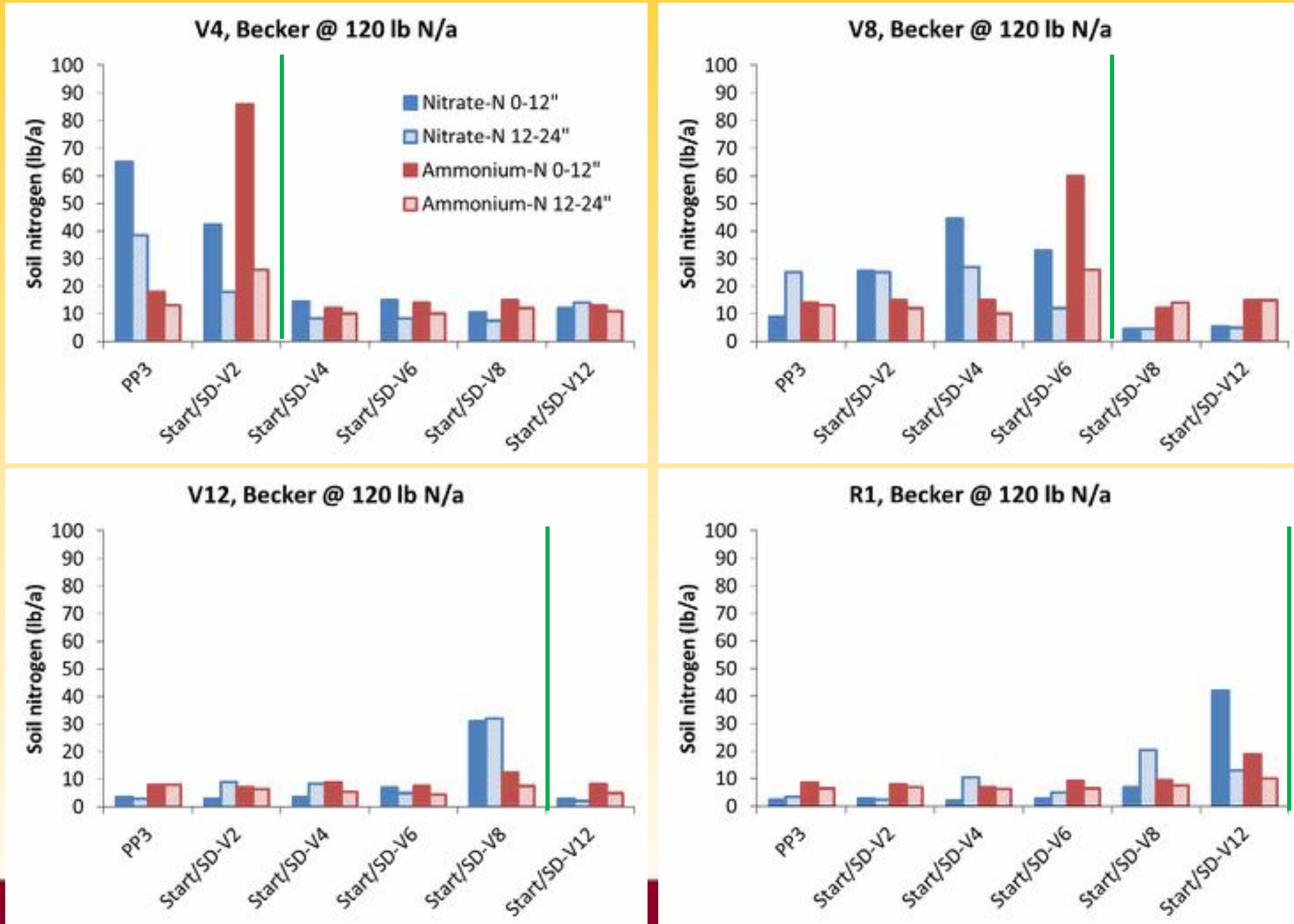


Hubbard loamy sand

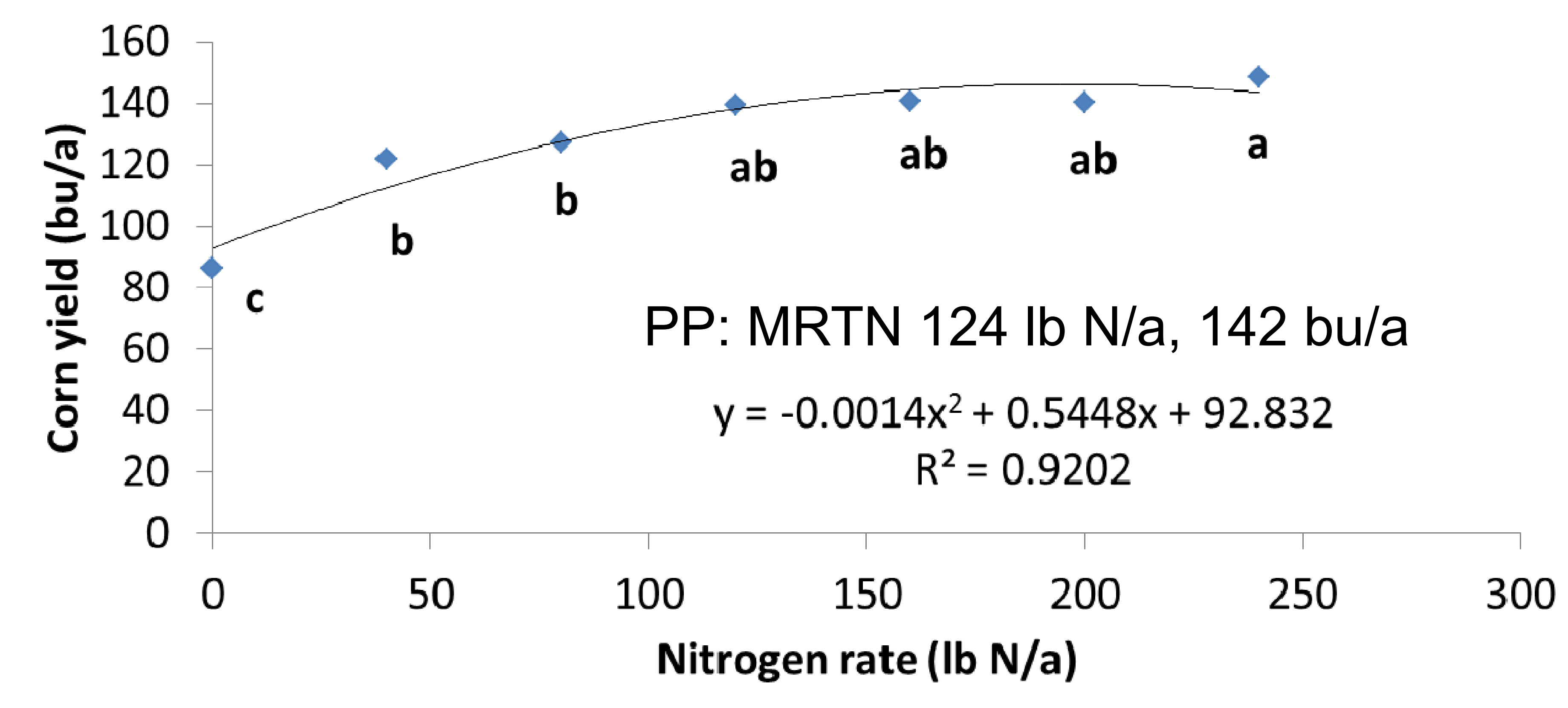
Becker, 2014 C-C at 120 lb N/a



Hubbard loamy sand

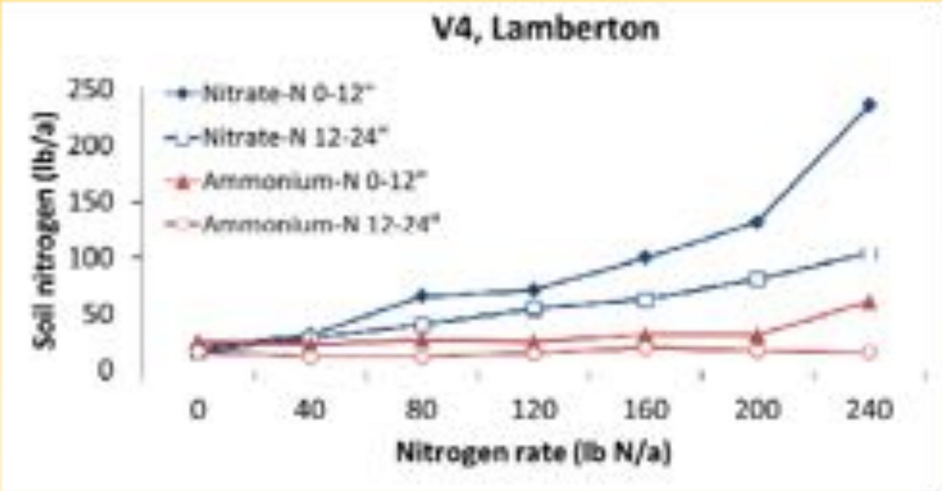

V4, Becker @ 120 lb N/a
V8, Becker @ 120 lb N/a
V12, Becker @ 120 lb N/a
R1, Becker @ 120 lb N/a
Soil nitrogen (lb/a)
100
90
80
70
60
50
40
30
20
10
0
Nitrate-N 0-12"
Nitrate-N 12-24"
Ammonium-N 0-12"
Ammonium-N 12-24"
PP3
Start/SD-V2
Start/SD-V4
Start/SD-V6
Start/SD-V8
Start/SD-V12

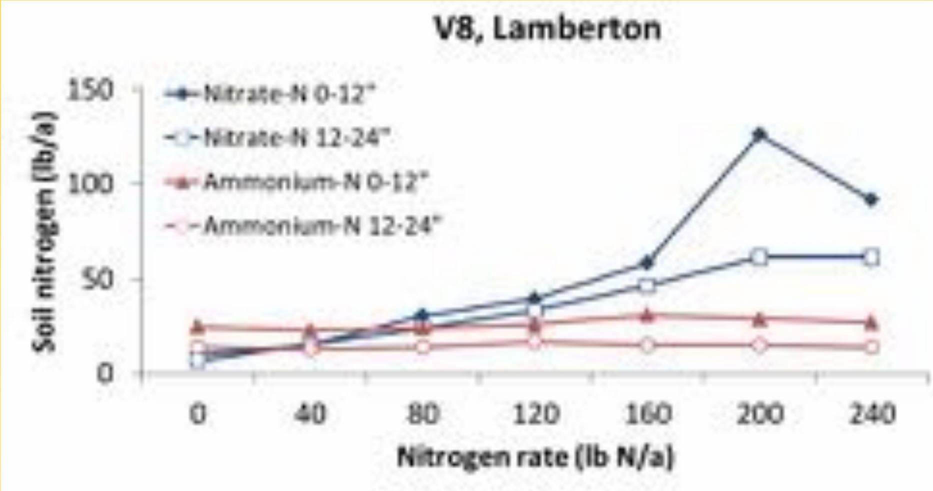
Lamberton, Yield



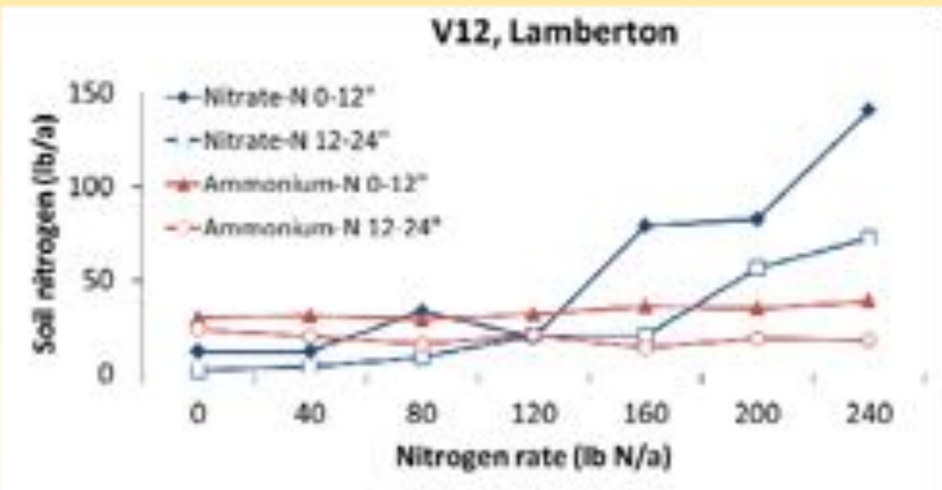
Ves loam soil

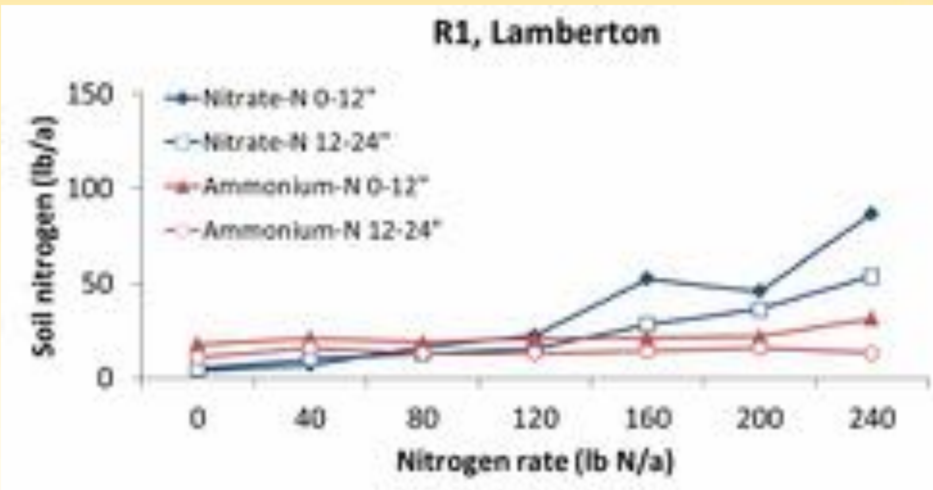
Soil N with Pre-plant Applications





Soil with 4% OM, CEC 24 meq/100g





Ves loam soil

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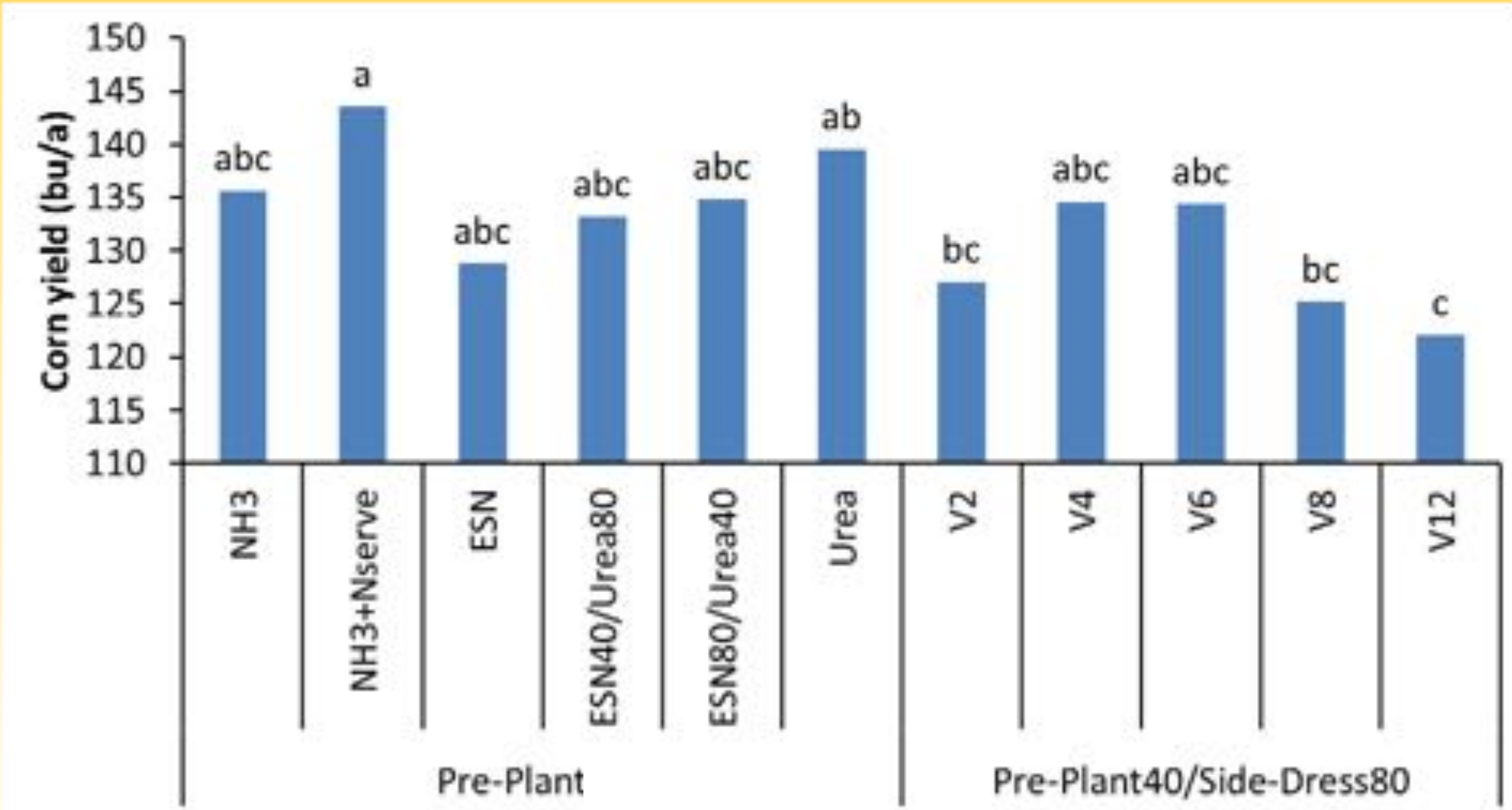
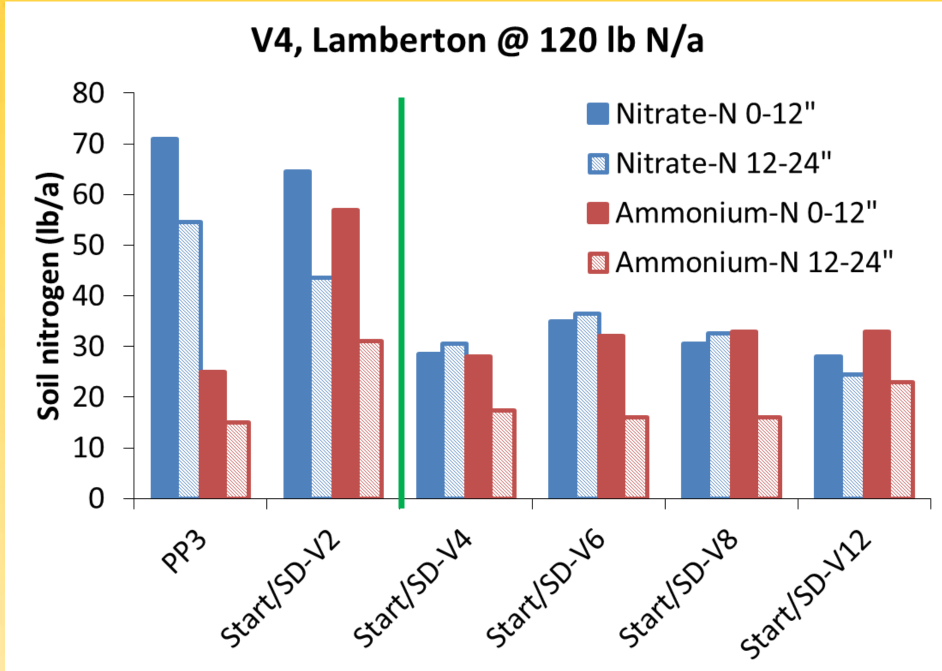
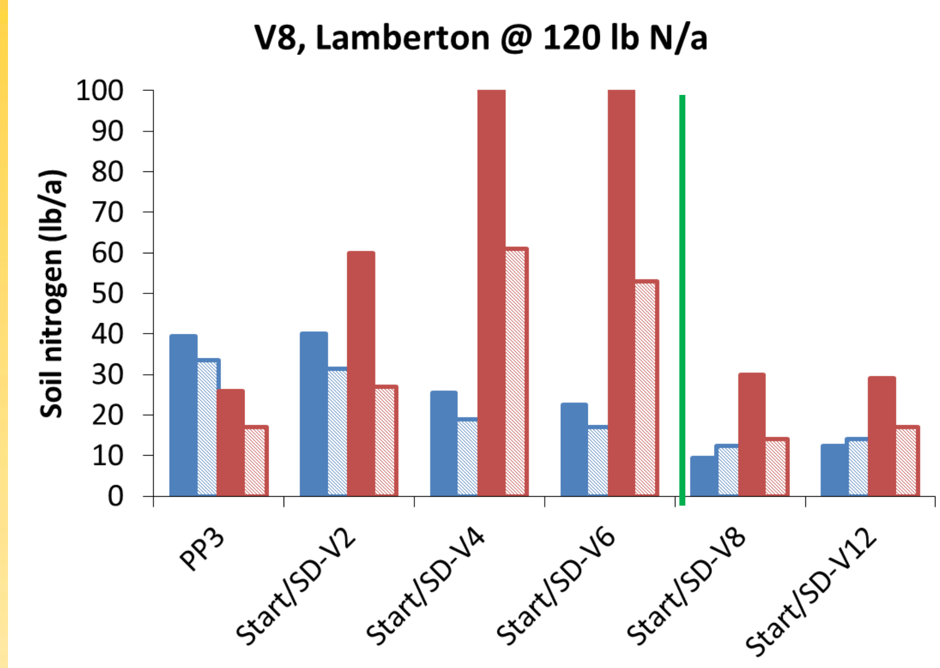
Lamberton, C-C at 120 lb N/a

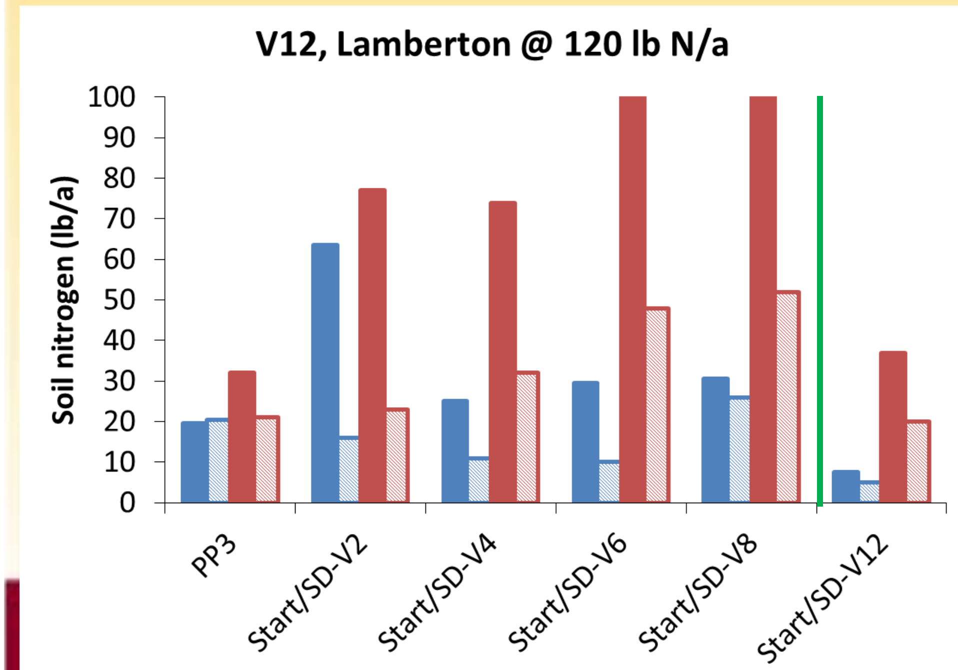




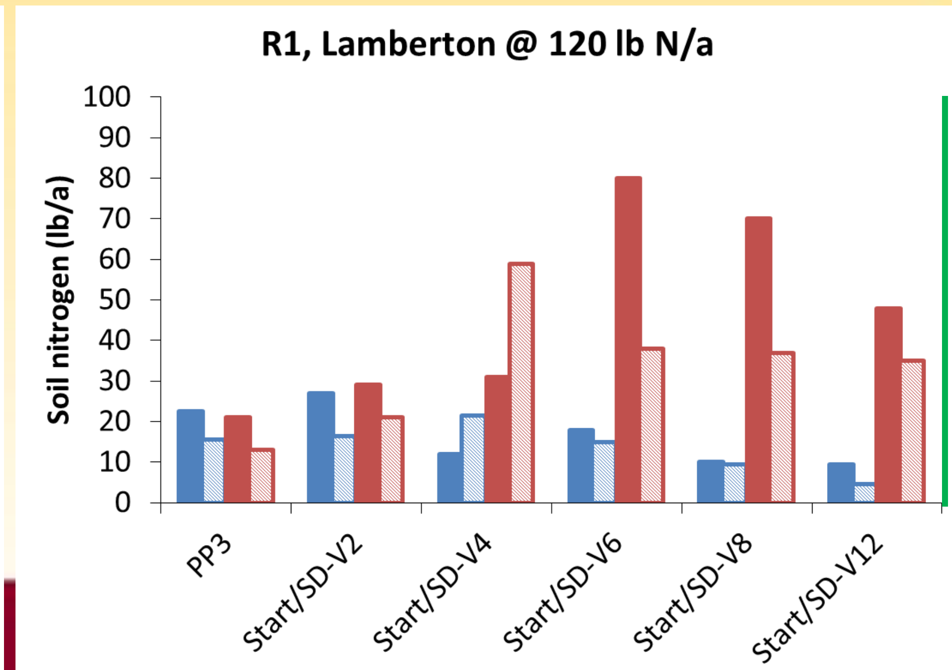
V4, Lamberton @ 120 lb N/a
Soil nitrogen (lb/a)
Nitrate-N 0-12"
Nitrate-N 12-24"
Ammonium-N 0-12"
Ammonium-N 12-24"
PP3
Start/SD-V2
Start/SD-V4
Start/SD-V6
Start/SD-V8
Start/SD-V12



V8, Lamberton @ 120 lb N/a
Soil nitrogen (lb/a)
PP3
Start/SD-V2
Start/SD-V4
Start/SD-V6
Start/SD-V8
Start/SD-V12



V12, Lamberton @ 120 lb N/a
Soil nitrogen (lb/a)
PP3
Start/SD-V2
Start/SD-V4
Start/SD-V6
Start/SD-V8
Start/SD-V12

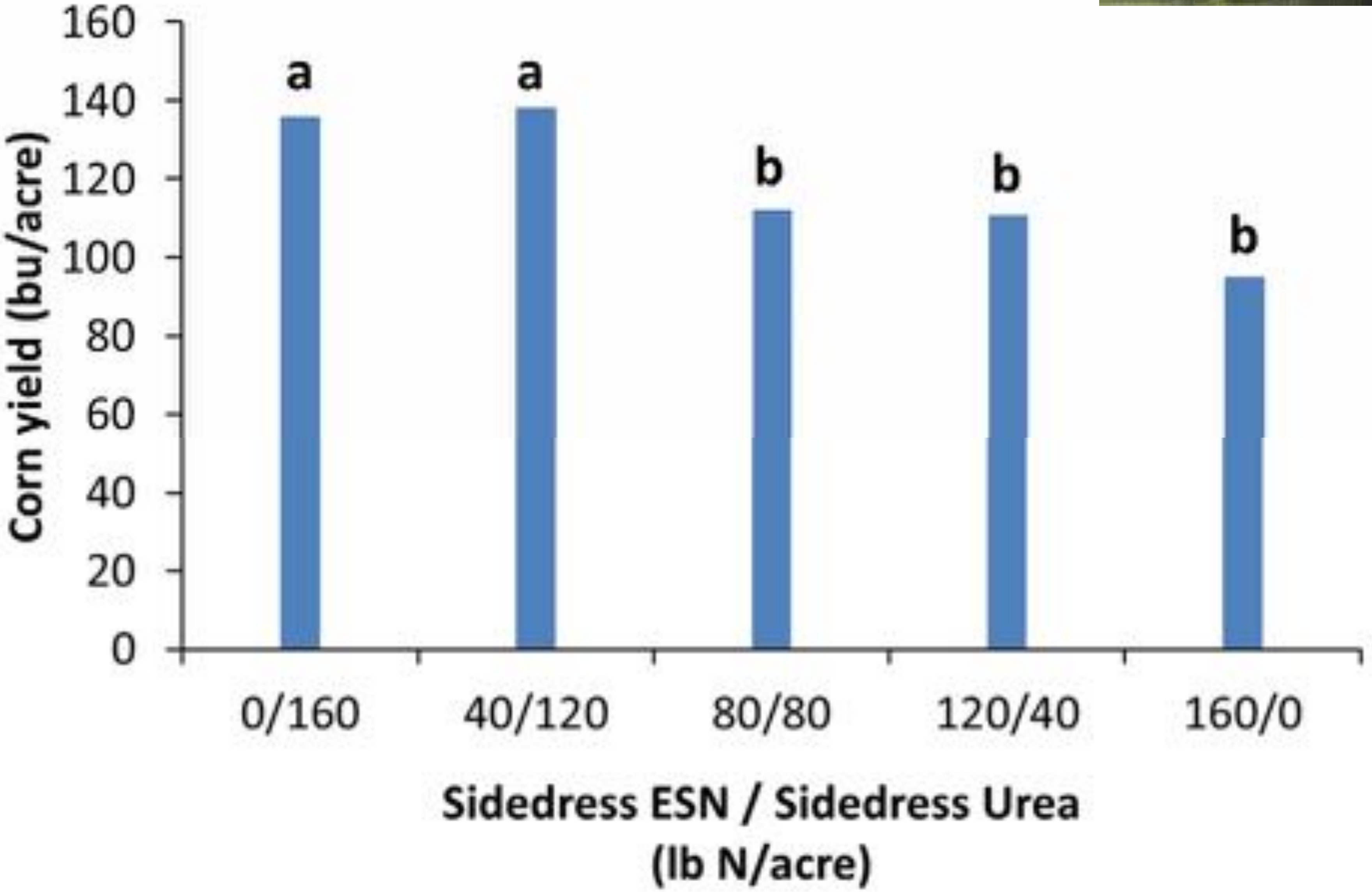


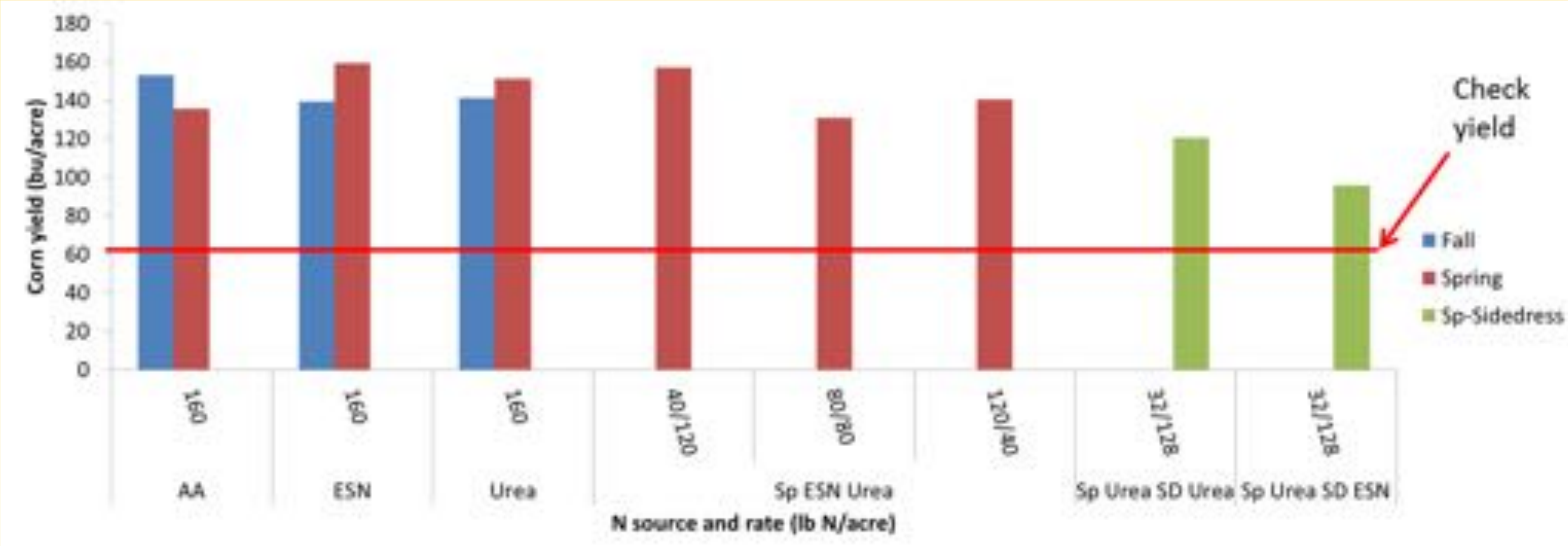
R1, Lamberton @ 120 lb N/a
Soil nitrogen (lb/a)
PP3
Start/SD-V2
Start/SD-V4
Start/SD-V6
Start/SD-V8
Start/SD-V12

Urea

PCU

Yield at 160 lb N/acre





Fall anhydrous ammonia (AA) had N-Serve
Sp= spring pre-plant within a weeks before planting
Planted May 19, 2011
SD= sidedress application end of June

Take Home Message

- Canopy sensing predicts yield better later in the season
- Soils can provide substantial amounts of N
  - Early in the season the crop normally has more than enough from the soil
- Split N applications work well for irrigated sands
- Split N applications in dry-land may produce similar yields to spring pre-plant
  - There may be non-agronomic benefits
  - Just like with pre-plant, split N carries risks

http://z.umn.edu/Nconference

Registration Opens at 8:00 am

Morning Sessions 9:00 am – 12:25pm		Speaker	Organization
9:00-9:05	Welcome	Dr. Fabián Fernández	University of Minnesota
9:05-9:55	Nitrogen Market Update	Dr. Robert Mullen	Potash Corp
9:55-10:45	Climate Trends And Their Implications	Dr. Mark Seeley	University of Minnesota
10:45-11:35	Irrigated Corn N Guidelines - What Are They And Where Did They Come From?	Dr. John Lamb	University of Minnesota
11:35-12:25	Can We Protect Groundwater Supplies Beneath Our Outwash Sands?	Bruce Montgomery	Minnesota Department of Agriculture

12:25-1:15 Lunch (provided by conference)

Breakout Sessions 1:15 pm – 3:45 pm		Speaker	Organization
Breakout Session 1. Predicting Nitrogen In-Season			
1:15-2:05	Database-Driven Guidelines To Manage Nitrogen Rate Decisions	Dr. John Sawyer	Iowa State University
2:05-2:55	Utility Of Sensor Technology For Making In-Season Recommendations For N	Dr. Daniel Kaiser	University of Minnesota
2:55-3:45	Opportunities And Challenges When Applying Nitrogen In-Season	Dr. Fabián Fernández	University of Minnesota
Breakout Session 2. Nitrogen Credits			
1:15-2:05	Manure Management To Minimize Nitrogen Loss And Improve Crop Use Efficiency	Kevan Klingberg	University of Wisconsin
2:05-2:55	Nitrogen Management For First- And Second-Year Corn Following Alfalfa	Dr. Jeffrey Coulter	University of Minnesota
2:55-3:45	Interseeded Cover Crops In Corn-Based Cropping Systems	Dr. Scott Wells	University of Minnesota
Breakout Session 3. Nitrogen Management for Sandy Soils			
1:15-2:05	Nitrogen Fertilizer Use Efficiency For Corn And Its Relationship To Groundwater Quality	Dr. Richard Ferguson	University of Nebraska
2:05-2:55	Evaluation Of Nitrogen Technologies For Sandy Soils	Dr. Carl Rosen	University of Minnesota
2:55-3:45	Fertigation As A Management Tool In Irrigated Corn	Joshua Stamper	University of Minnesota

Thank You!

- U of M Nutrient Management Group
- Graduate & Undergraduate Students, post Docs

- Research Center Personnel and Farmers
- Funding entities:

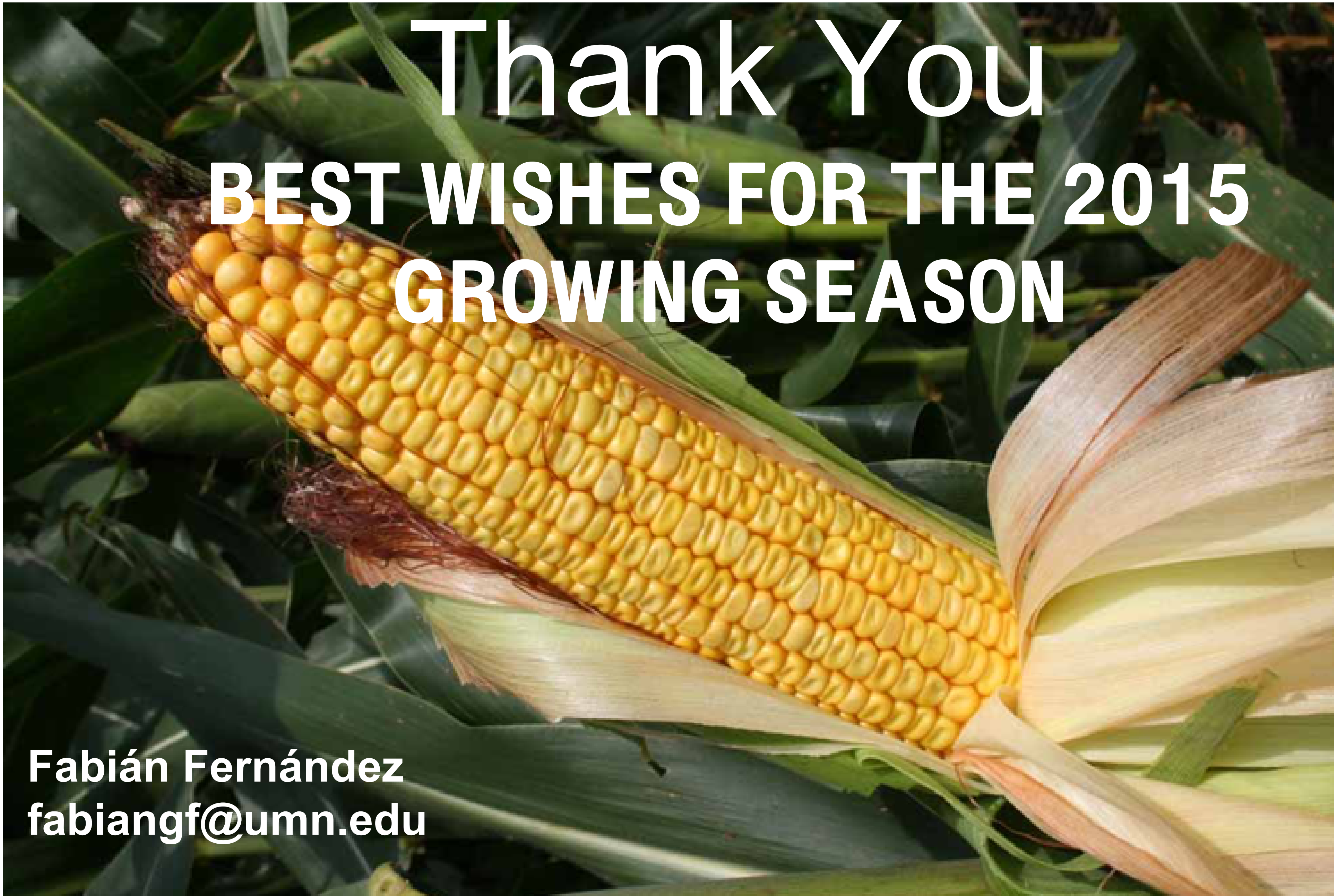
MinnesotaCorn GROWERS ASSOCIATION

Minnesota Soybean Research & Promotion Council

Minnesota's Agricultural Fertilizer Research & Education Council

Thank You

BEST WISHES FOR THE 2015 GROWING SEASON



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