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Where do U of M Recs come from? - N calculator updates

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RATE: THE DILEMMA

- Very difficult to know the correct rate until after the growing season
- Virtually impossible to see how much is being applied
- Rate can mask other bad practices
- Long-standing “anti-UofM rates” message
  - Yield based rates
- New technology

WHAT'S GOING ON OUT THERE?

- 2012 NASS report
  - 71% of corn/soybeans in MN above 140 lb./A
  - 34% over 155 lb./A
  - 17% of corn/corn above 180 lb./A
- 2016,17, 18 Adult Farm Management Records (SE, SC, SW, WC MN)
- Fertilizer cost per acre (manure users excluded)
  - 20% most profitable farms - $138, $107, $108
  - 20% least profitable farms - $177, $134, $131
  - 28%, 25%, 21% difference
  - Seed 11%, 12%, 7%

HISTORY LESSON – PRE-1974

- 1.2 X Yield – (sum of credits) = rate
- Replaced in 1974 in SC and SE
- Kept as an option until 1982

ENTER YIELD GOAL (CHANGED TO EXPECTED YIELD IN 2000)

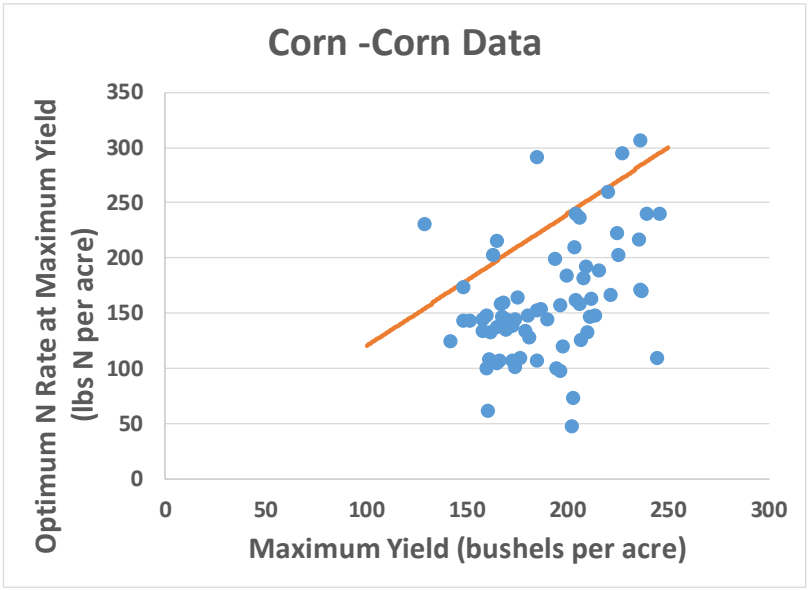
Table 20. Nitrogen recommendations for corn production for situations where the soil nitrate test is not used.

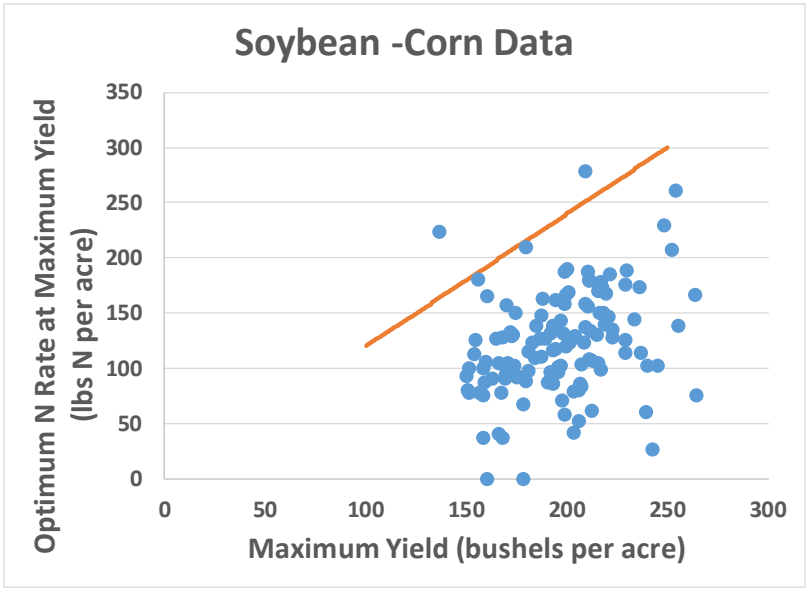
Crop Grown Last Year	Organic* Matter Level	Yield Goal (bu./acre)						
		70-90	91-110	111-130	131-150	151-170	171-190	191+
		-N to apply (lb./acre)-						
alfalfa (4+ plants/ft²), nonharvested sweet clover	low	0	0	0	0	30	50	70
"	medium and high	0	0	0	0	0	20	40
soybeans small grains,** alfalfa (1 or less plants/ft²)	low	20***	50***	80***	110	140	160	180
"	medium and high	0	30	60	80	110	130	150
edible beans, field peas, harvested sweet clover	low	40	70	100	130	160	180	200
"	medium and high	20	50	80	100	130	150	170
Group 1 crops	low	0	15	45	75	105	125	145
"	medium and high	0	0	15	45	75	95	115
Group 2 crops	low	60	90	120	150	180	200	220
"	medium and high	40	70	100	120	150	170	190

MAXIMUM RETURN TO NITROGEN (MRTN) – 2005 TO PRESENT

- Multi-State effort to give consistency in how recommendations are made
  - Recommendations made by state
- Incorporates economics
- Acknowledges changes in crop N use
  - No need for soybean N credit
- Can be easily updated with recent data

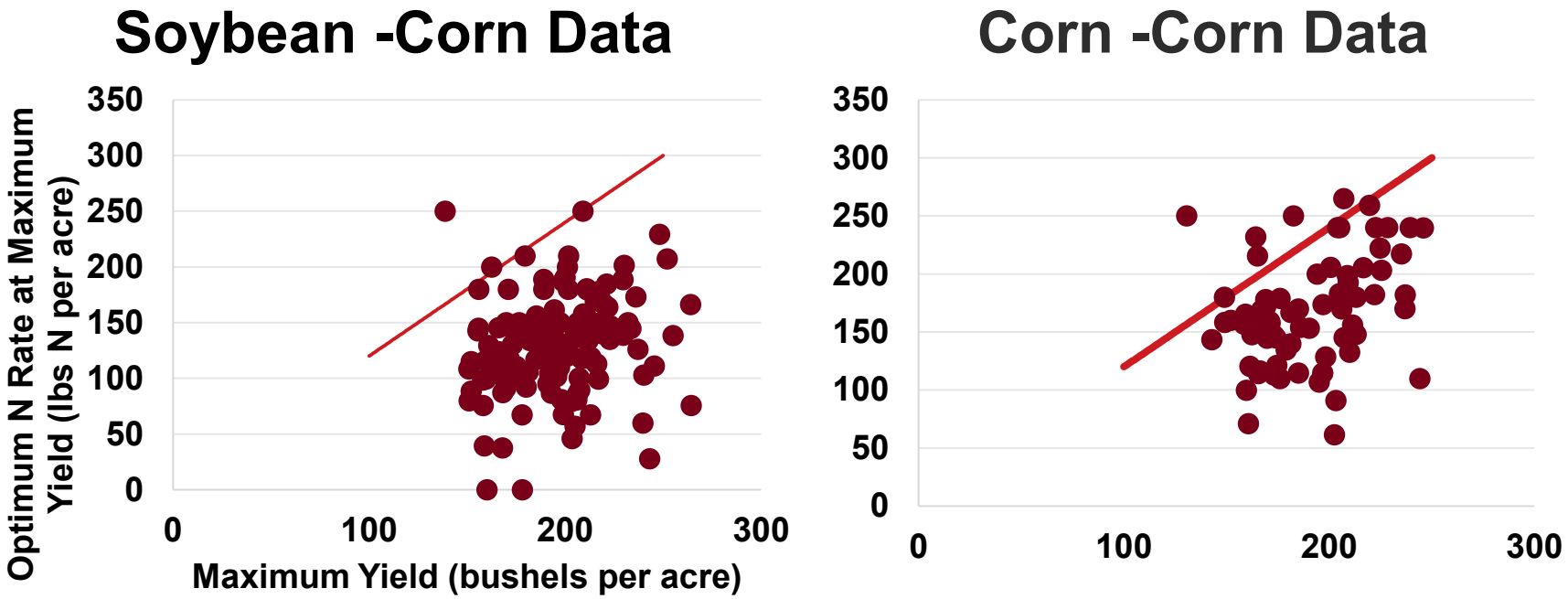
MINNESOTA DOES NOT USE YIELD GOAL





N rate based on 1.2 X yield

YIELD GOAL BASIS DOESN'T WORK



N rate based on 1.2 X yield

How to predict the optimum rate?

- Maximum Return to Nitrogen (MRTN)
  - University of Minnesota guidelines
  - Target the rate where the last $ invested in N produces $ increase in yield
- Yield goal (e.g. 1.2 lbs N/bu expected)
  - Doesn't work
- Modeling
  - Depends on good data

Right Rate

EONR - Economic Optimum Nitrogen Rate

- The actual optimum rate for a specific field and season
- Can be adjusted for price of N

You can't know the optimum rate at the time you need to make fertilizer decisions!

Input state, rotation here. Input prices on input-results sheet, NOT here.

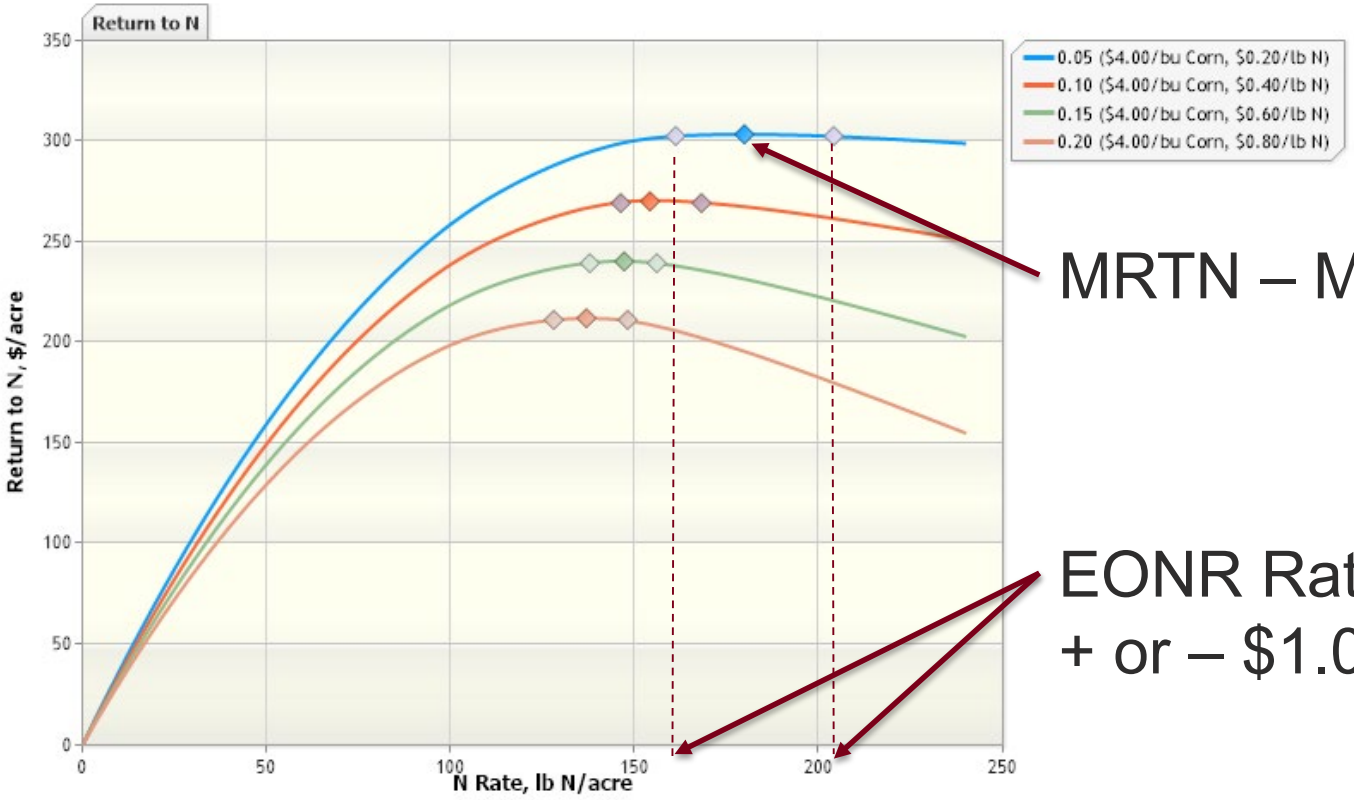
SC

N Cost:	0.40	$/lb N
Corn Price:	4.00	$/bu
Ratio:	0.100	

Example of Data in the Corn N rate Database

	Sites	90-04	90-10	91-02	91-03	91-13	92-03	92-06	92-21	92-23	94-10	95-15	96-09	9
	Max N Applied (lb N/acre)	150	150	150	150	180	180	150	120	120	120	120	120	
	a	146.88	106.48	89.07	94.78	137.10	107.76	115.40	107.00	117.00	100.20	127.00	109.50	11
	b	0.43488	1.15928	1.14452	0.85024	0.81170	0.80000	0.82600	0.67500	2.11360	0.63350	0.46670	1.31250	0.8
	c	########	########	########	########	########	########	########	.	########	.	.	########	###
	Plateau N (lb N/acre)	100.7	150.0	145.6	142.7	125.7	145.5	88.4	75.6	39.4	80.0	91.1	100.0	1
	Plateau Yield (bu/acre)	168.8	197.3	172.4	155.4	188.1	165.9	151.9	158.0	158.7	150.9	169.5	175.2	1
	Calculation													
	Optimum N (lb N/acre)	77.5	143.5	132.9	125.9	110.2	127.3	77.7	75.6	37.6	80.0	91.1	92.4	1
	Optimum Yield (bu/acre)	167.6	196.9	171.8	154.6	187.3	165.0	151.4	158.0	158.6	150.9	169.5	174.8	1
lb N/acre	Calculation													
0	N Rate (lb N/acre)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Yield RTN (bu/acre)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Yield RTN ($/acre)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	N Cost (lb/acre)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	N Cost ($/acre)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
	Net RTN ($/acre)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
	Yield (bu/acre)	146.9	106.5	89.1	94.8	137.1	107.8	115.4	107.0	117.0	100.2	127.0	109.5	1
1	N Rate (lb N/acre)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
	Yield RTN (bu/acre)	0.4	1.2	1.1	0.8	0.8	0.8	0.8	0.7	2.1	0.6	0.5	1.3	
	Yield RTN ($/acre)	1.7	4.6	4.6	3.4	3.2	3.2	3.3	2.7	8.3	2.5	1.9	5.2	
	N Cost (lb/acre)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
	N Cost ($/acre)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0
	Net RTN ($/acre)	1.33	4.22	4.16	2.99	2.83	2.79	2.89	2.30	7.95	2.13	1.47	4.82	3
	Yield (bu/acre)	147.3	107.6	90.2	95.6	137.9	108.6	116.2	107.7	119.1	100.8	127.5	110.8	1
2	N Rate (lb N/acre)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
	Yield RTN (bu/acre)	0.9	2.3	2.3	1.7	1.6	1.6	1.6	1.3	4.1	1.3	0.9	2.6	
	Yield RTN ($/acre)	3.4	9.2	9.1	6.8	6.4	6.4	6.5	5.4	16.5	5.1	3.7	10.4	
	N Cost (lb/acre)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
	N Cost ($/acre)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0
	Net RTN ($/acre)	2.64	8.42	8.29	5.95	5.64	5.56	5.73	4.60	15.68	4.27	2.93	9.60	6
	Yield (bu/acre)	147.7	108.8	91.3	96.5	138.7	109.3	117.0	108.4	121.1	101.5	127.9	112.1	1

EONR – ECONOMIC OPTIMUM N RATE

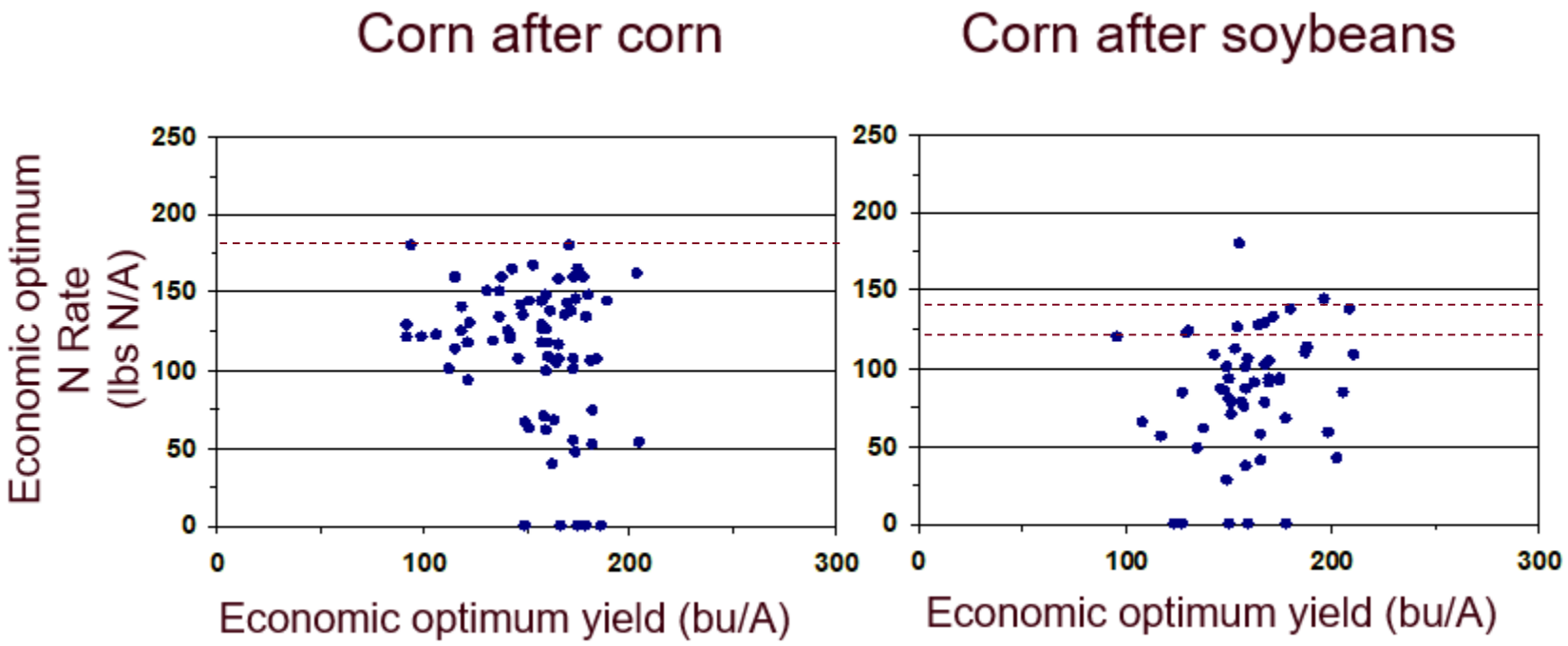


MRTN – Maximum Profit

EONR Rate Window – + or – $1.00

RISK MANAGEMENT

- How many years in 5?
- How many sites?



TO BE CLEAR

- MRTN is NOT the average!
- The recommendation considers most sites, NOT 50% above and 50% below

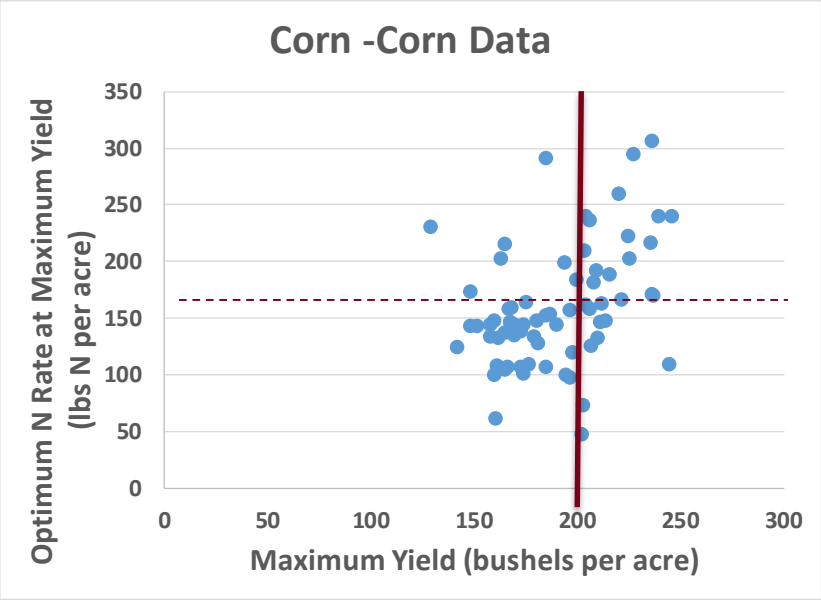
- The MRTN window is enough N for MOST sites
  - +- $1 from MRTN

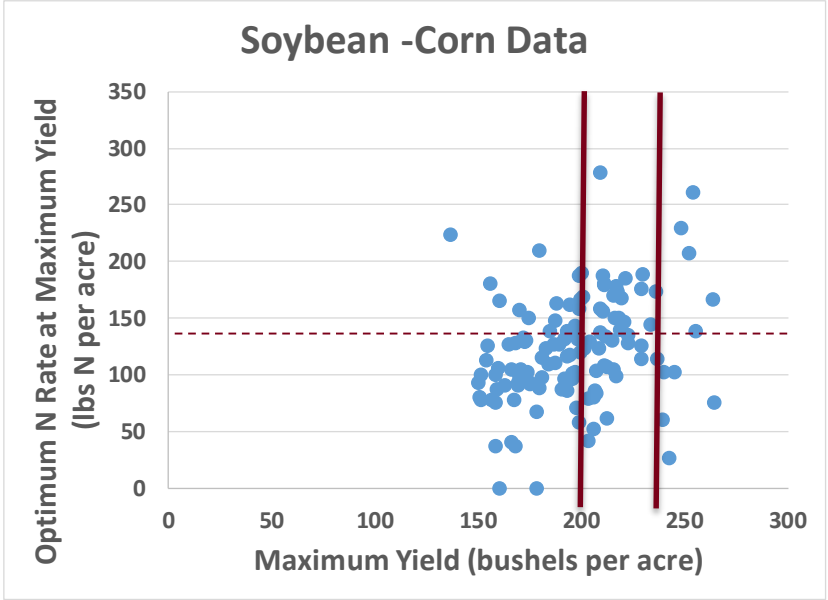
DIGGING INTO THE DATABASE

- C-C Sites : 200 bu/ac + Yield
  - Range 200-246 bu/ac
    - Optimal N
      - Mean/Median 183 lb N
- C-SB Sites : 200 bu/ac + Yield
  - Range 200-264 bu/ac
    - Optimal N
      - Mean/Median 135 lb N

RISK MANAGEMENT

- Likelihood of needing a higher rate?

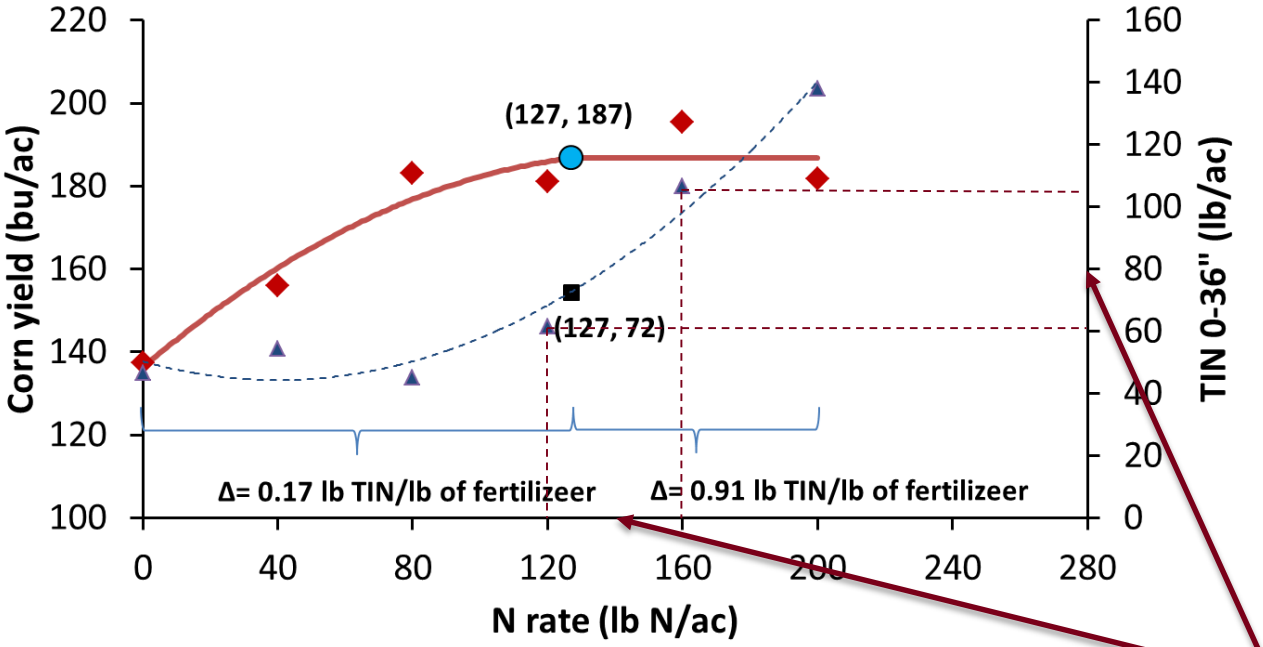




OPTIMAL YIELD VS N RATE

- Variability in optimal N rate is largely based on environmental factors
  - Soil productivity
  - Amount of rainfall
  - Rainfall timing (during year)
- How do you plan if you don't know what is going to happen the next year
- While optimal N rates have increased there is no direct evidence that the increase is a direct result of greater yield

EXCESS N IS LEFT BEHIND



40 lbs.!

Fernandez, 2014

HISTORICAL LOOK AT DATABASE

N price/Crop value ratio	Corn/corn MRTN	Corn/corn Flexible range	Corn/soybean MRTN	Corn/soybean Flexible range
unitless	---------- pounds N per acre ----------			
0.05	155	130 to 180	120	100 to 140
0.10	140	120 to 165	110	90 to 125
0.15	130	110 to 150	100	80 to 115
0.20	120	100 to 140	85	

2005

2016

Guidelines for use of nitrogen fertilizer for corn grown following corn or soybean when supplemental irrigation is not used. (2016)

N price/Crop value ratio	Corn/Corn MRTN	Corn/Corn Acceptable range	Soybean/Corn MRTN	Soybean/Corn Acceptable range
	---------- lb N/acre ----------			
0.05	180	160 to 200	140	125 to 160
0.10	155	145 to 170	120	105 to 130
0.15	150	140 to 155	105	95 to 115
0.20	140	130 to 150	95	85 to 105

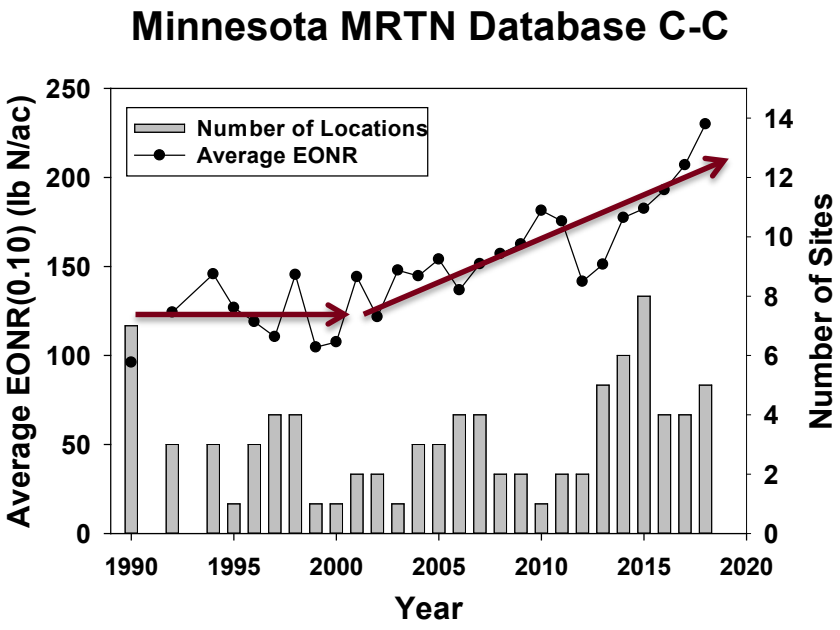
Minnesota N Rate Guidelines

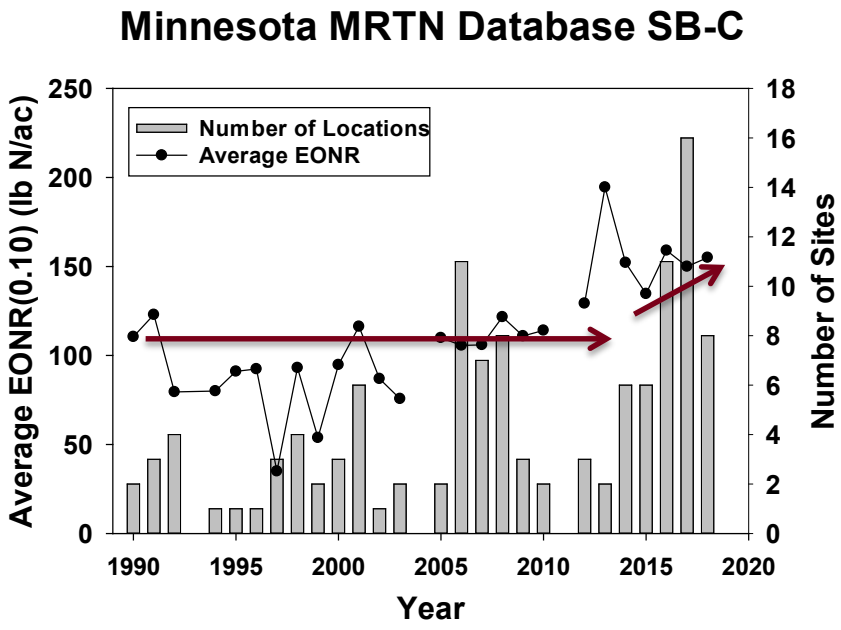
Guidelines for use of nitrogen fertilizer for corn grown following corn or soybean when supplemental irrigation is not used. (2019)

N price/Crop value ratio	Corn/Corn		Soybean/Corn	
	MRTN	Acceptable range	MRTN	Acceptable range
	---------- lb N/acre ----------			
0.05	195	180-210	150	135-165
0.10	165	150-180	130	120-145
0.15	150	140-160	115	105-125
0.20	145	135-155	105	95-115

http://cnrc.agron.iastate.edu/nRate.aspx

YEARLY EONR TRENDS





What factors are resulting in an increase in the EONR?
Will the EONR values continue to increase or level out?

Average MRTN across States

(0.10 N price : corn value ratio)

	Following Corn	Following Soybean
	--------- lb N/acre ---------	
Illinois	204	166
Iowa	188	140
Minnesota	165	131
Wisconsin	162	121

Corn yield at the zero-N rate as a percent of yield at EONR (0.10 price ratio).

State	Previous Crop	
	Corn	Soybean
	---------- %	----------
Illinois	54	64
Iowa	45	75
Minnesota	60	76
Wisconsin	75	80

MN CORN PRODUCER TRIAL

- Flat rate – 100 PP + 70 lb.N/ac SD.
- Split application, Encirca, R7, PSNT
  - 100 lbs N applied PP
- Replicated 5 times
- Each method used to make a whole field prescription

MinnesotaCorn

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PRESCRIPTIONS

- Overall rate compared to BMP rate - 2017
  - Encirca entirely below BMP
  - R7 mostly at or below BMP
  - PSNT 50% above BMP rate

MinnesotaCorn

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RESULTS

Treatment	Yield	Moisture	Avg. N Rate
Encirca	250.8	22.9	152
SD	247.8	22.9	169
PSNT	248.4	23.0	172
R7	254.1	22.8	164

LSD – 13.3 bu./ac.

Of 5 reps Encirca best in 2, R7 best in 2, Flat Rate best in 1

All plots received 100 lbs N pre-plant

MinnesotaCorn

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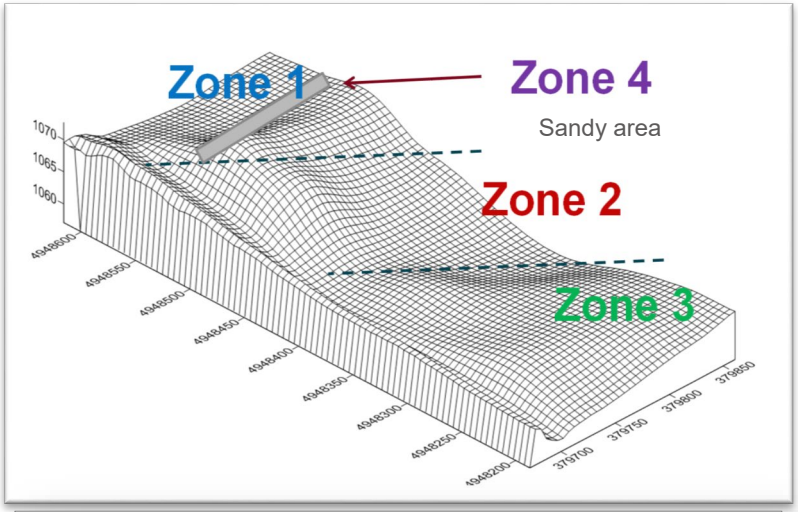
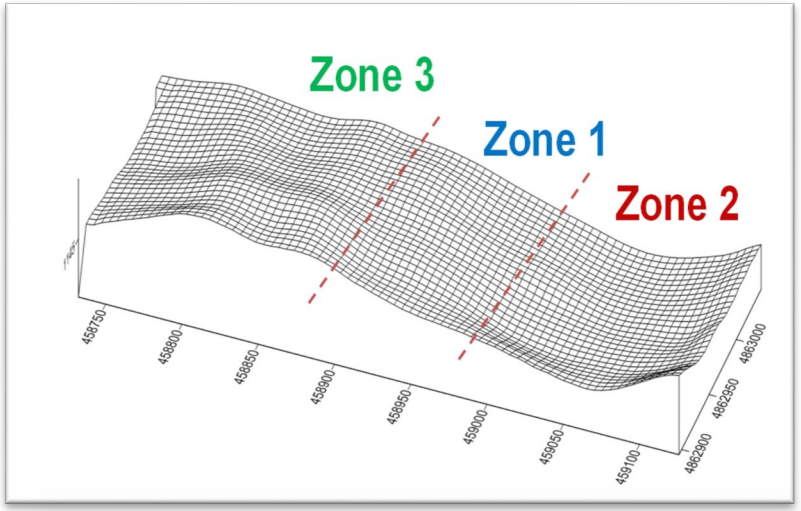
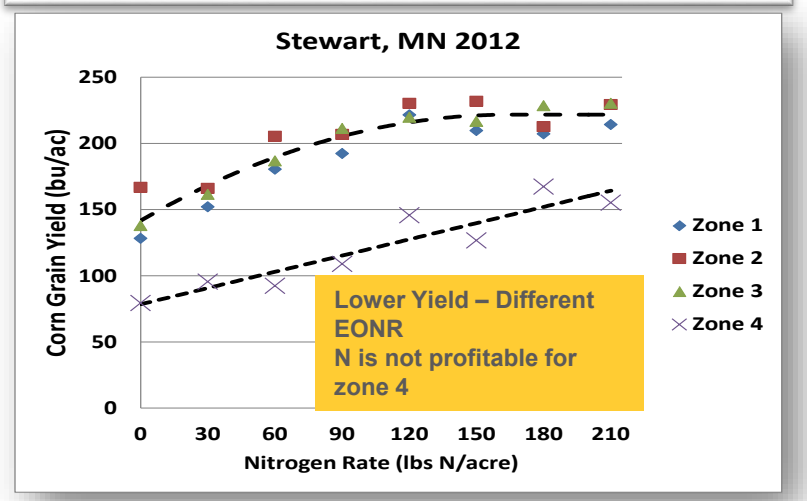
TAKE HOME MESSAGES - VRN

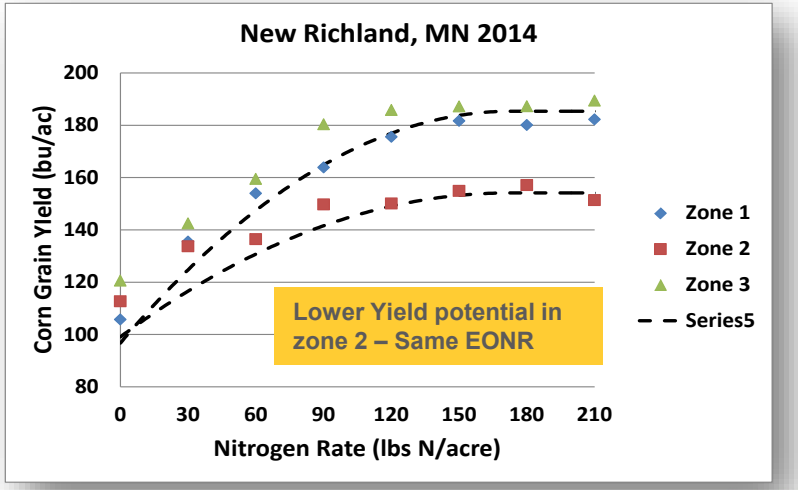
- Understanding N behavior is essential to both use and evaluation of VRN technology
- Early results indicate some VRN technology works (depending on your definition)
- Recommendations are likely to result in reduced inputs but not increased yield

Consider the following: 4.5 ac area









Rate, alone, is not a BMP

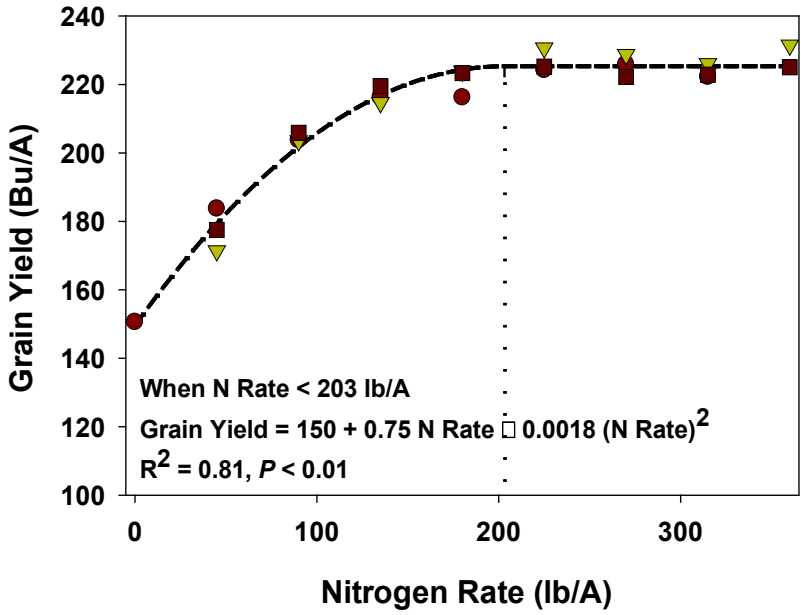
- **R**ight **P**lacement
- **R**ight **R**ate
- **R**ight **S**ource
- **R**ight **T**ime

IN CONCLUSION

- Start with U of M recommendations and go from there
  - Rate is one thing
  - Getting source and timing right may be more important
- Avoid bad practices – like fall urea
- Follow fertility practices that make economic sense and are research based
- If you deposited fertilizer into your soil bank account, now is the time to withdraw

Something to ponder

- Does increased mineralization of N from soil organic matter reduce the rate of N to apply or do years with greater mineralization set us up for higher yield potential
  - When is mineralized N important to the crop?



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