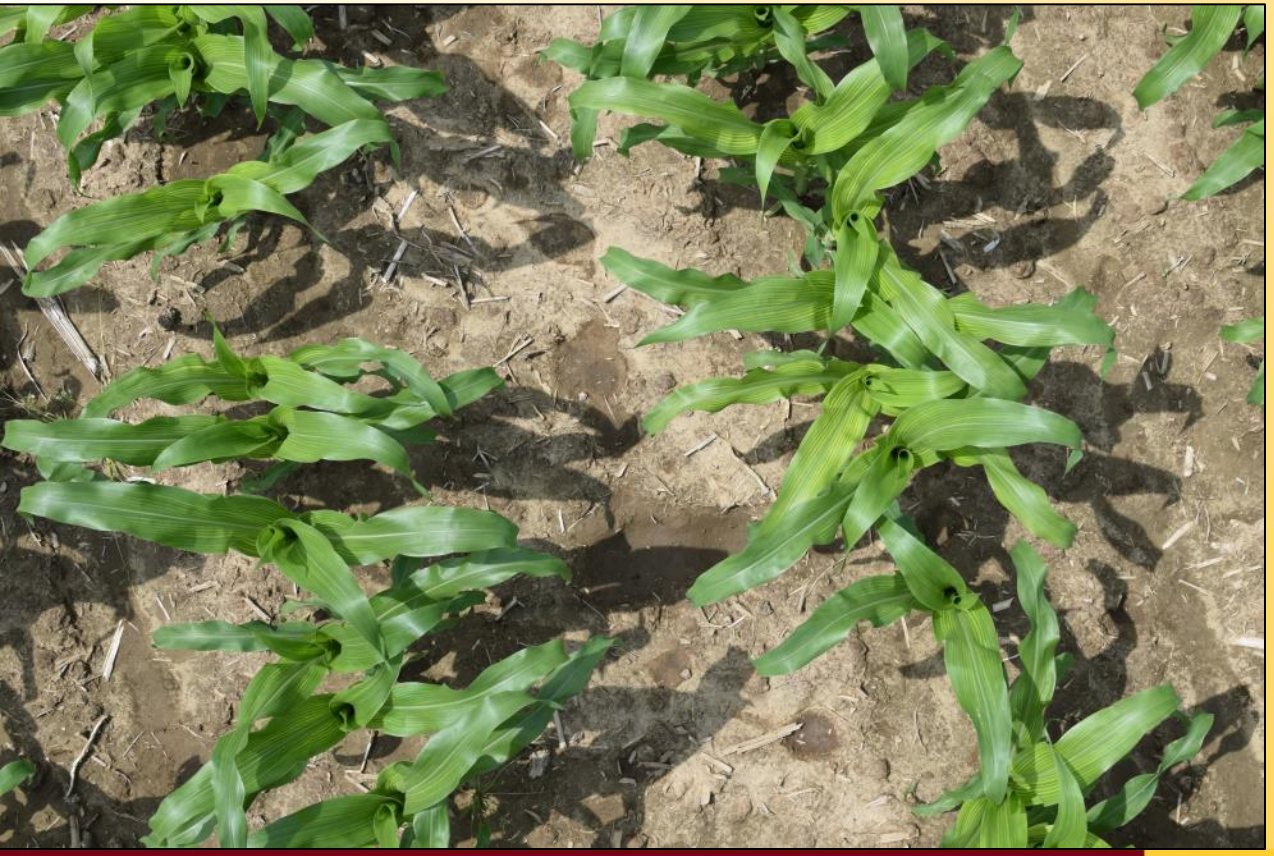
Comparison of ATS placement methods to enhance yield of continuous corn



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2017
Fluid Forum

Sulfur in Minnesota

- Increased prevalence of deficiencies in corn
  - More common for soils with limited S supply (organic matter content <3.0% 0-6”)
- Increases in corn grain yield with as little as 10 lbs of sulfate-S broadcast
- Producers are still concerned about fall application of sulfate-S on Med-Fine textured soils
- Some producers considering application of sulfur with the planter

Net Return over the Rotation

		Red Wing				Rochester			
Nutrient	Rate	2 yr	4 yr	6 yr	Total	2 yr	4 yr	6 yr	Total
	lb/ac	----------$/acre----------							
Phosphorus	120	0.0	-48.0	80.0	32	-48.0	-96.0	-8.0	-152
Potassium	100	-4.0	31.0	96.0	123	-40.0	-50.0	4.0	-86
	200	-44.0	47.0	56.0	59	-80.0	-60.0	-11.0	-151
	300	-84.0	30.0	16.0	-38	-120.0	-100.0	-51.0	-271
Sulfur	25	15.5	148.0	180.5	344	-12.5	59.0	73.0	119.5

- P rates are in lb P_2O_5/ac - 0.40/lb
- K rates are in lb K_2O/ac – $0.40.lb
- S - $0.50/lb Corn $4/bu Beans $10/bu
- Applied P and K rate may not be the “optimum rate” for each site
- Application cost is not factored into net return

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Net Return over the Rotation

		Becker				Lamberton			
Nutrient	Rate	2 yr	4 yr	6 yr**	Total	2 yr	4 yr	6 yr**	Total
	lb/ac	----------$/acre----------							
Phosphorus	120	-16.0	58.0	108	150	-48.0	58.0	40.0	50
Potassium	100	-84.0	-40.0	-40.0	-164	-40.0	40.0	4.0	4
	200	-144.0	-80.0	-80.0	-304	-80.0	0.0	-36.0	-116
	300	-204.0	-120.0	-120.0	-464	-120.0	-40.0	-76.0	-236
Sulfur	25	-12.5	-12.5	-12.5	-37.5	15.5	-12.5	-12.5	-9.5

- P rates are in lb P_2O_5/ac - 0.40/lb
- K rates are in lb K_2O/ac – $0.40.lb
- S - $0.50/lb Corn $4/bu Beans $10/bu
- Applied P and K rate may not be the “optimum rate” for each site
- Application cost is not factored into net return

**only 2016 corn data included

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PKS Study Locations

	Year		Bray P1-P			NH_4OAC-K			SOM
Location	Est.		YR 1	YR3	YR5	YR 1	YR 3	YR 5	
			--------ppm-------						-%-
Red Wing	2011	SiL	34	29	20	91	77	73	2.2
Rochester		L	32	28	18	172	169	114	3.4
Becker	2012	LS	20	9	8	86	74	62	2.1
Lamberton		L	14	14	9	107	113	88	4.6

YR3 & YR5 data represents the average value for the control (No P, K, or S)
Colors represent expected response to applied fertilizer
blue – low, green – moderate, red - high

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June 21, Waseca
193 bu/A, 21%
209 bu/A, 16%
0 gal/A 10-34-0
0 gal/A UAN
0 gal/A ATS
4 gal/A 10-34-0 In-
8 gal/A UAN S. ba
4 gal/A ATS S. ba

Starter P and S for Continuous Corn - Yield

Rochester 2010	Waseca 2010	Rochester 2011	Waseca 2011
----------bushels/acre----------			
APP (10-34-0) in-furrow			
208a	214a	***195b***	194a
210a	214a	***199a***	198a
UAN (28-0-0) surface dribble band			
209a	216a	197a	195a
209a	212a	198a	197a
ATS (12-0-0-26) surface dribble band			
209a	***209b***	***194b***	196a
209a	***218a***	***196b***	197a
210a	***215a***	***202a***	196a

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J. Vetsch – U of M SROC

Sulfur Guideline Changes Minnesota 2016

- New guidelines assume a sulfate source is being used
- Application of elemental S is risky if being applied to a S deficient situation
- No reason to exceed a rate of 25 lbs S/ac

Table 12. Broadcast Sulfate-Sulfur guidelines for corn grown in Minnesota			
	0-6" Soil Organic Matter Concentration		
Crop Rotation	0-2%	2-4%	4%+
	lb S/acre as SO_4-S		
Soybean/Corn	10-25	10-15	0*
Corn/Corn	10-25	10-15	5-10**
Sandy Soils	25	25-25	15-25

*Research data suggest that a rate of 10 lbs of sulfate S may be warranted when corn follows soybean on poorly drained calcareous soils

**A low rate of S is suggested when corn follows corn and SOM is 4% or greater. A rate of 10-15 lbs of S is suggested for corn following corn on reduced tillage in the presence of high levels of surface residue

Renville, MN
June 2014

2014

- No S No Fe
  - 155 bu/ac
- + S No Fe
  - 168 bu/ac
- + S + Foliar Fe
  - 171 bu/ac

2015

- No Fe
  - 223 bu/ac
- + 3-6 GPA Redline
  - 221 bu/ac

Research Questions

- Minnesota has maintained a efficiency factor for banded sulfur application
  - Reduce rate by 50%
- ATS is part elemental S and part sulfate-S
  - Is a rate reduction warranted?
- Some growers are utilizing ATS with pre-emerge herbicides
  - Is this a good idea?

Research Objectives

1. Determine if a surface band application of S as ATS is more efficient than broadcast application of ATS or AMS
2. Determine if pre-emerge broadcast application of ATS is as an effective source of applying S compared to AMS broadcast at or before planting in continuous corn.

Materials and Methods

- 2 locations per year in continuous corn
  - 1 location where soil organic matter is ≤3.0%
  - 1 location on poorly drained soil (>3.0%)
- Sulfur Source x Timing
  - AMS applied at or before planting
  - ATS surface dribble band with the planter
  - ATS applied on the soil surface
- Sulfur Rate
  - 0, 2.5, 5, 10, and 20 lbs S/ac
- Nitrogen was balanced with Urea or UAN

Locations: 2015-2016

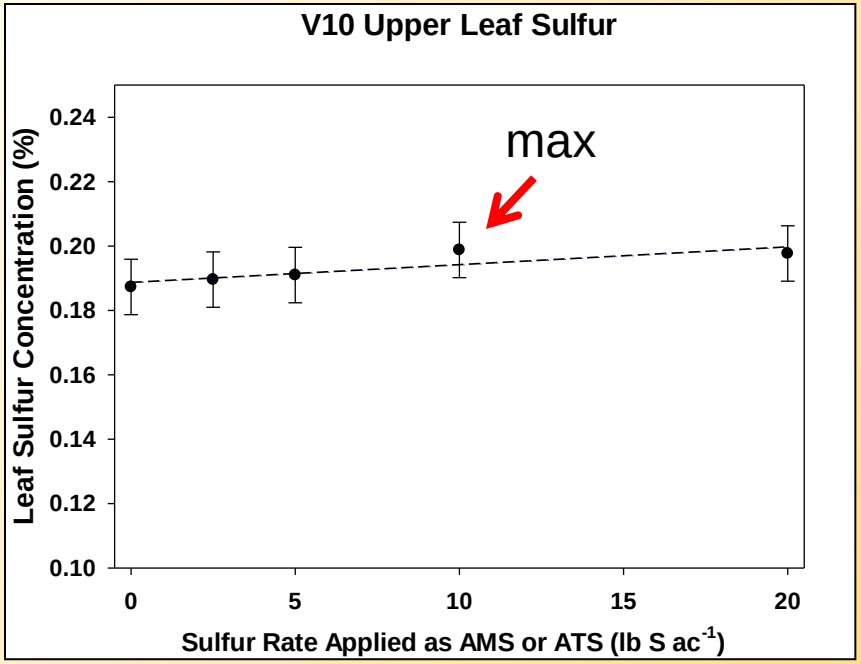
		Soil		Soil Test (0-6")					0-2’
Year	Location	Series	County	P	K	SO_4-S	OM	pH	SO_4-S
				----------ppm-------			-%-		-lb/ac-
2015	New Richland	Clarion	Waseca	20	134	7	2.9	5.7	42
	Waseca	Webster	Waseca	13	165	6	5.5	6.3	33
2016	Lamberton	Storden	Redwood	12	100	5	3.5	6.2	41
	Renville	Okaboji	Renville	***12***	175	6	7.8	7.7	42

P, Bray-P1 phosphorus; K ammonium acetate potassium; SO_4-S, mono-calcium phosphate extractable sulfate sulfur; OM, organic matter loss on ignition; pH, 1:1 soil:water.
†Olsen P test was used

Ear Leaf %S at V10 and R2

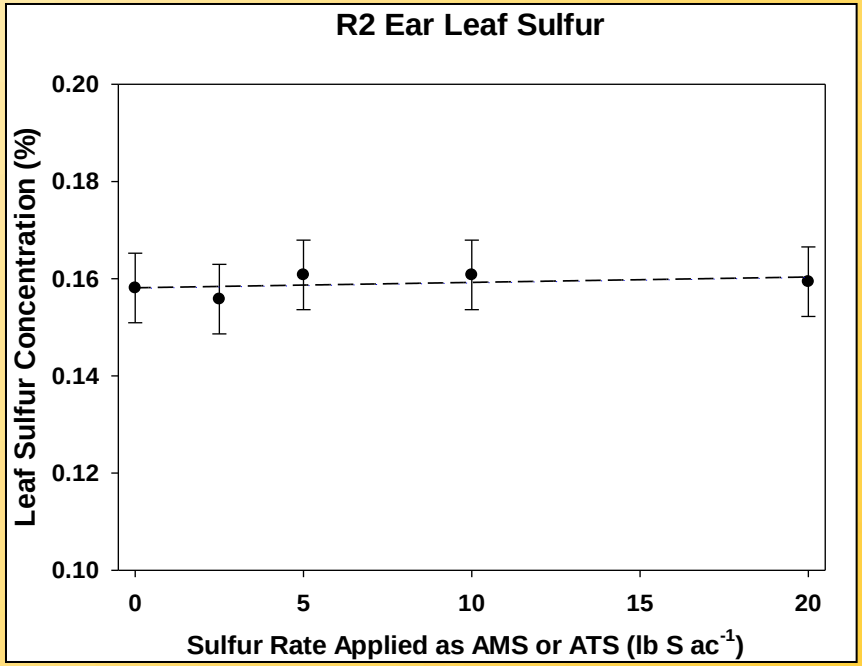
V10 Upper Leaf

S rate – *P*<0.01



R2 Ear Leaf

S rate - ns



Thanks to:

Corn Grain Yield Data 2015

	New Richland†				Waseca†			
S Rate	AMS-Br	ATS-Br	ATS-Ba	Avg.‡	AMS-Br	ATS-Br	ATS-Ba	Avg.‡
-lb S/ac-	----------bu/ac----------							
0	222	225	229	225	212	213	204	210
2.5	221	241	216	226	204	215	206	209
5.0	218	242	228	229	213	213	212	213
10.0	231	218	216	222	210	221	209	213
20.0	225	233	227	228	220	216	214	216
Avg.‡	223b	232a	223b		212	216	209	

† Sulfur source: ATS-Ba, Ammonium thiosulfate banded; ATS-Br, ammonium thiosulfate broadcast; AMS-Br, ammonium sulfate broadcast.

‡ Avg., treatment mean; within rows and columns, numbers followed by the same letter are not significantly different at the P≤0.05 probability level.

Corn Grain Yield Data 2016

	Lamberton†				Renville†			
S Rate	AMS-Br	ATS-Br	ATS-Ba	Avg.‡	AMS-Br	ATS-Br	ATS-Ba	Avg.‡
-lb S/ac-	----------bu/ac----------							
0	213	203	203	206	222	210	209	214
2.5	209	205	196	204	222	209	218	216
5.0	214	194	212	207	231	214	221	222
10.0	208	210	202	207	221	226	215	221
20.0	207	224	207	213	227	219	230	225
Avg.‡	210	207	204		225a	216b	219b	

† Sulfur source: ATS-Ba, Ammonium thiosulfate banded; ATS-Br, ammonium thiosulfate broadcast; AMS-Br, ammonium sulfate broadcast.

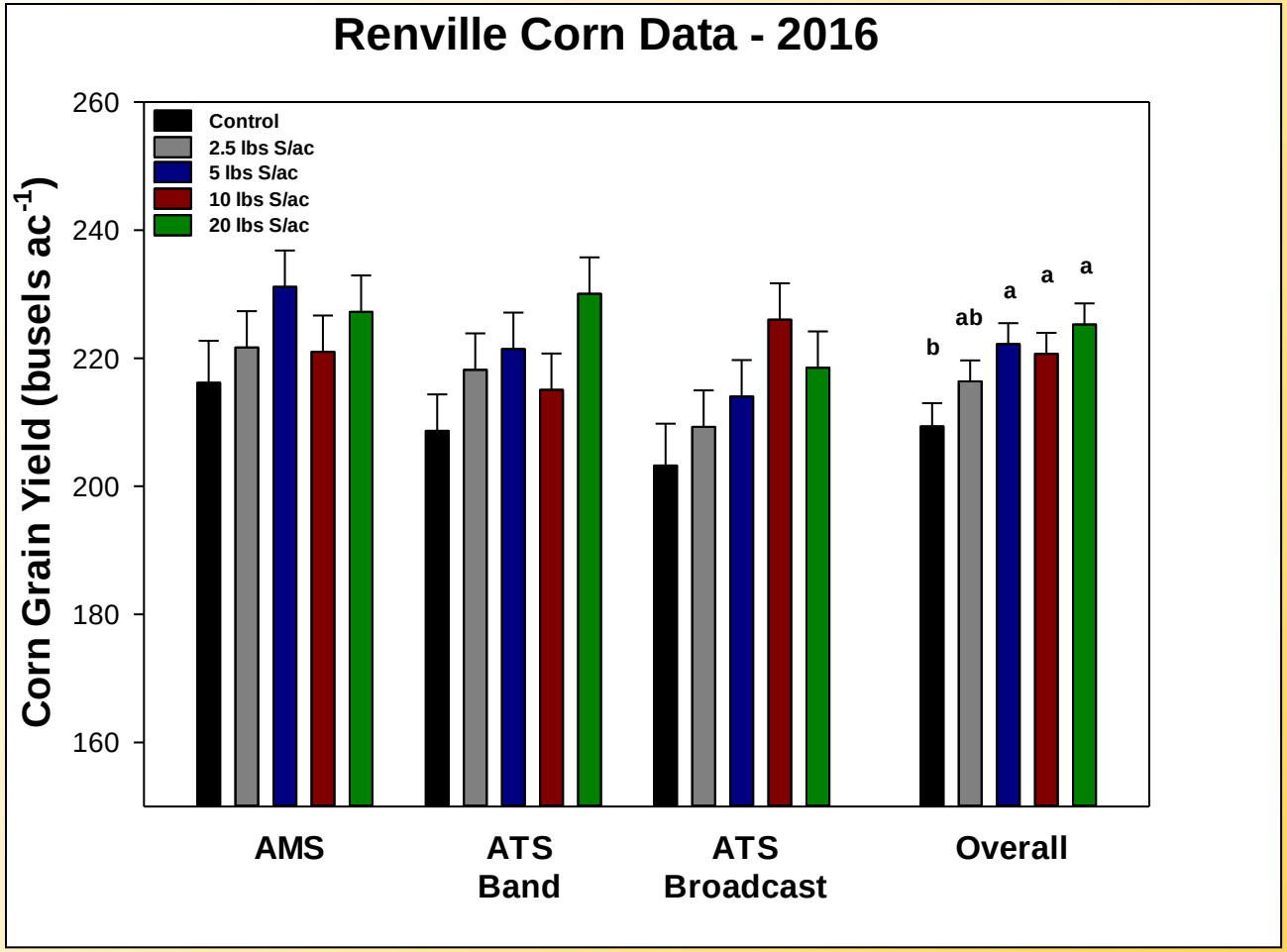
‡ Avg., treatment mean; within rows and columns, numbers followed by the same letter are not significantly different at the P≤0.05 probability level.

2-Year Overall Effects

Sulfur Rate	V5 NDRE	Grain Yield
---lb S ac^{-1}---		----bushels ac^{-1}----
0	0.320b	212b
2.5	0.323b	214b
5	0.323b	216ab
10	0.323b	215b
20	0.331a	219a

*No evidence of a significant difference among source or interactions between source and rate

Renville Data Revisited



Data after cleaning out a few outliers

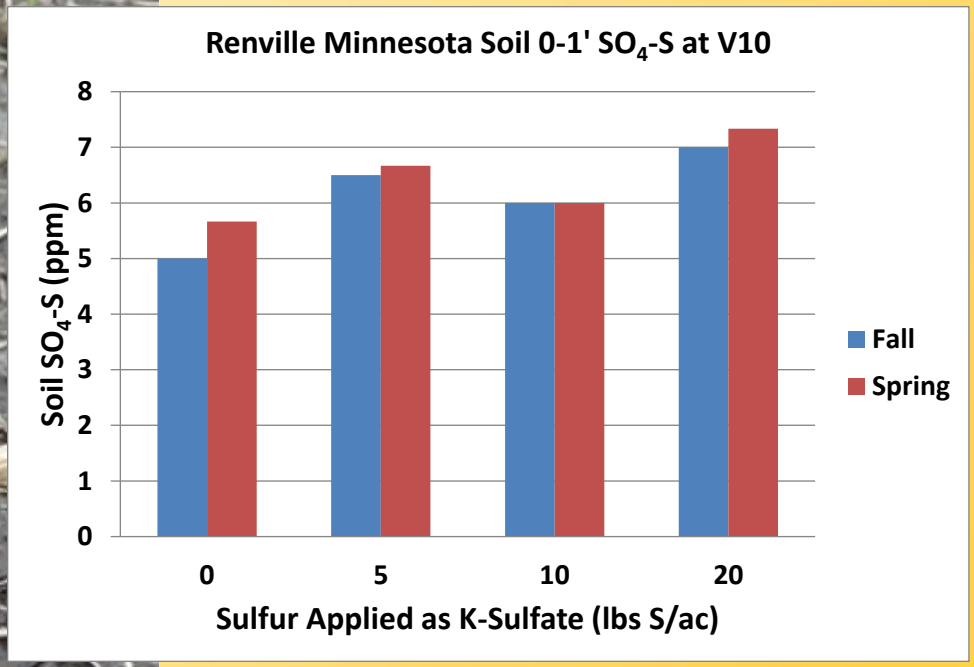
AMS – 223a
ATS Band – 219ab
ATS Broad – 214b

No significant interaction between source and rate

Significant variation in the amount of yield produced in the control among sources

Optimum rate – 5 lbs S/ac

Renville, MN
June 2016



Spring application of 5 lbs of S resulted in statistically similar soil SO_4-S as 20 lbs of S

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Minnesota Practices

- With the application of S increasing it is getting hard to find large yield responses due to S in 1-year trials
- Farmers want to apply S with their P and K in the fall
  - Many farmers utilize elemental S because they are concerned about leaching of SO4-S
- The use of in-furrow starter is still strong in some areas
  - Sulfur application in-furrow is still risky

Preliminary Conclusions

- The optimal rate of S on some higher (>3.0%) organic matter soils may be small (5 lb/ac)
  - ATS banded was as effective as AMS
  - Banding ATS would concentrate S near the root zone and would be better option than broadcast ATS which could increase the effectiveness of the SO4-S
- I would like to see more growers utilize a UAN/ATS option with the planter or as an early side-dress instead of fall applied elemental S
  - Flexibility to move some N application to spring


Thank You
Questions?
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