Advantages of Sulfur in Starter Fertilizer

John A. Lamb
Department of Soil, Water, and Climate
University of Minnesota

In The Past

- alfalfa, corn, canola, small grains responded to S
- response when S applied to sandy soils
- soil tests not reliable in predicting need for S in a fertilizer program
- based S recommendations on soil texture

The Sulfur Situation Today

- more reduced tillage systems
- less sulfur dioxide in the atmosphere
- could these factors affect S fertilization guidelines?

Sulfur Supplied From

- soil (95% of total is in the organic matter)
- atmosphere
- irrigation water

Sulfur Mineralized In Minnesota Soils

County	Text.	OM	Int. S	12 wk S	Change
		%	ppm	ppm	lb./a
Wad.	sl	1.2	2.1	3.0	1.8
Good.	sil	1.6	3.7	7.1	6.8
Good.	sil	2.4	6.2	11.7	11.0
Wab.	sil	2.7	6.3	17.6	22.6

Sulfur Mineralization and Texture

- The number of pounds of S mineralized for each % organic matter varied from 1.5 to 8.4.

Atmospheric Sulfur Deposition

Location	Initial Year	2000	% change
		lb. S/acre	
Kalamazoo MI (1979)	27.5	6.8	-75
Wooster OH (1979)	31.0	17.9	-42
Lamberton MN (1979)	15.8	5.5	-65

Estimated S Removal—Harvested Crops

Crop	S Removal
alfalfa	6.0 lb./ton
corn grain	.09 lb./bu.
oats grain+straw	.16 lb./bu.
soybean grain	.16 lb./bu

Sulfur Fertilizers

- Elemental S
- Sulfur-clay mixes (90% elemental S)
- Ammonium sulfate (21-0-0-24)
- Ammonium thiosulfate (12-0-0-26), liquid
- K-Mag (22% S), good for alfalfa and corn because of 22% K2O

Sulfur In Manures

Source	Dry		Liquid	
	lb.S/ton		lb.S/1,000 gal.	
dairy	1.5	0.8	4.2	2.3
swine	2.7	1.5	7.6	4.2

Source: Iowa State University

Sulfur deficiency on Corn

Soil Texture and Sulfur for Corn

Texture	No S	25 lb. S/acre
	bu./acre	
silty clay loam	132	128
loamy fine sand	168	177

Soil Properties—Sulfur Response

S Rate	Goodhue Co.	Wabasha Co.
lb./acre	bu./acre	
0	155	169
10	169	170
40	169	174
organic matter,%	1.6	2.7
Sulfate- S ,ppm	9.0	6.0

Can we put sulfur on at planting?

- Study conducted from 1999 to 2001

Seed vs 2X2 Placement

- 2X2 vs Seed placement
- Ammonium sulfate (21-0-0-24)
- Ammonium Thiosulfate (12-0-0-26)
- 0, 6, 12, and 18 lb S per acre
- Six sites
  - 5 in ridge-tillage, 1 disk-tillage

Sites

Site ID	Year	Texture	Spring moisture
LFS-99	1999	loamy fine sand	Normal
SCL-99	1999	silty clay loam	Normal
LFS-00	2000	loamy fine sand	Very dry
L-00	2000	loam	Normal
SAL-01	2001	sandy loam	Very dry
SiL-01	2001	silt loam	Normal

Population concerns

- Seed placement can be a double edged sword.

Populations/Non affected sites

	12-0-0-26		21-0-0-24	
S rate	2X2	With seed	2X2	With seed
lb S/A	-- % of 0 pounds S per acre ---			
6	104	101	101	102
12	101	97	102	98
18	104	99	102	100

4 of 6 sites, LFS-99, SCL-99, L-00, SiL-01

Populations/affected sites

	12-0-0-26		21-0-0-24	
S rate	2X2	With seed	2X2	With seed
lb S/A	-- % of 0 pounds S per acre ---			
6	102	91	100	97
12	95	67	100	95
18	103	51	100	98

LSF 2000 Very dry at planting.

Populations/affected sites

	12-0-0-26		21-0-0-24	
S rate	2X2	With seed	2X2	With seed
lb S/A	-- % of 0 pounds S per acre ---			
6	90	89	106	93
12	89	88	105	95
18	89	69	105	83

SAL 2001 Very dry at planting.

Populations

- No problems if soil is not sandy and not dry.
- If there are problems, source and placement are important.
  - No problems with ammonium sulfate.
  - Problems with seed placement of ammonium thiosulfate.
- Prediction of dry soil conditions in sandy soils tough.

Grain yield responses

		0 S	6 S
Site ID	S response	Grain yield (bu/A)	
LFS-99	Yes	168	176
SCL-99	No	187	187
LFS-00*	Yes	101	110
L-00	Yes	153	163
SAL-01*	Yes	142	156
SiL-01	Yes	151	162

* Very dry at planting.

Grain yield

- Five of six sites had a significant grain yield response to sulfur.
- One site was a silty clay loam.
- Sulfur needed in sandy and reduced tillage situations.

Sulfur Application At Waseca

	Yield			
Trt	2004	2005	2006	2004-2006 Ave.
lb./acre			bu./acre	
-S	192	167	207	188
+S	197	165	227	196

2007 Field Trials

- 6 sites: all in farmers' fields
- 2 treatments (with and without S)
- collect soil samples
- measure emergence and yields
- 3, 4, or 6 replications

Soil Test Values

Prop.	Olm	Meek	Free	Wat	YM-A	YM-S
pH	6.4	7.2	5.4	7.8	6.9	7.7
P*	23	28	32	14	30	23
K*	122	208	149	191	165	180
%OM	--	7.6	5.7	5.7	4.4	4.6
S*	4	11	5	12	5	7

* Values for P, K, and S are in ppm

Plant population

	OLM[+]	Meek	Free	Wat	YM-A	YM-S
	---------- plants per acre ----------					
No S	25047	22700	31444	29261	29092	31872
S	28241	22900	32222	29123	28529	31186
# S/A	12	5.7	3.7	1.9	5.7	5.7

[+] Olmsted was 2X2 placement of elemental S.
The rest were liquids placed on seed.

Corn grain yield

	OLM+	Meek	Free	Wat	YM-A	YM-S
	---------- bushels per acre ----------					
No S	192	123	177	177	118	179
S	191	125	171	173	119	174*
# S/A	12	5.7	3.7	1.9	5.7	5.7

+ Olmsted was 2X2 placement of elemental S.
The rest were liquids placed on seed.


MEEK. S TRIAL
6G 10 • 34 • 0
2G 12 • 0 • 0 • 26
MEEK. S TRIAL
6G 10 • 34 • 0

Summary

- S placed near the seed did reduced stand at only 1 of 6 sites. The reduction was only 700 plants per acre. Dry spring.
- Grain yield reduced by S at 1 of 6 sites—probably due to reduced stand

Thinking About Changes

- less atmospheric deposition
- less tillage; therefore less mineralization
- response measured at Waseca
- no yield increase at 6 sites in MN in 2007

Suggestions For Future S Guidelines

- Soil texture is still major consideration
- Don’t use soil test as a guide
- Probability for need when corn is planted with conservation tillage on low O.M. soil (<2.0%)
- If soil is sandy, no S with the seed

Questions