AMMONIUM THIOSULFATE EFFECTS ON CORN PRODUCTION

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Ammonium thiosulfate ($(NH_4)_2S_2O_3$, ATS) and urea-ammonium nitrate solution (UAN) were applied in different combinations to corn grown in five site-year studies to assess any effects of ATS on corn performance. Ammonium sulfate ($(NH_4)_2SO_4$, AS) was included in three of these comparisons as an alternate sulfur (S) treatment. Adding ATS to UAN increased corn yield in one comparison, decreased it in another and had no effect on yield in others. Adding AS had no effect on corn yield. Neither S material influenced ear leaf N or S concentrations in a manner which was related to yield change.

OBJECTIVES

1. To evaluate effects of adding ATS to UAN on corn grain yield.

2. To determine whether any effect due to ATS was related to N or S nutrition as determined by elemental concentrations in ear leaves.

MATERIALS AND METHODS

Studies were conducted at Ohio Agricultural Research and Development Center stations at Springfield (1987), Wooster (1987-1989) and Hoytville (1989). The Springfield study was conducted on a tile-drained Kokomo silty clay loam (Typic Argiaquolls), the Hoytville study on a tile-drained Hoytville silty clay (Mollic Ochraqualfs), and studies at Wooster on a Canfield silt loam (Aquic Fragiudalfs) in 1987, and on a Riddles silt loam (Typic Hapludalfs) in 1988 and 1989. Surface soil pH was 6.5 at Springfield, 6.8 at Hoytville, and 6.0-6.2 at Wooster sites. Soil phosphorus and potassium levels at all sites were in excess of those needed for maximum yield at study inception and were maintained by yearly additions to replace nutrients removed at harvest.

Study designs and details varied between locations and years (Table 1); however, all studies involved growing corn fertilized with UAN solutions (28-0-0 in 1987, 32-0-0 in 1988 and 1989) which were or were not amended with ATS solution (12-0-0-26S) or reagent-grade AS at different S rates for different treatments. Sulfur amendments were added to UAN before application. Nitrogen solutions were applied by broadcasting over the entire plot surface using a sprayer equipped with flat-fan nozzles, or by dribbling using drop tubes that placed N on the surface in a narrow band midway between alternate rows. All corn was planted in 30-inch row spacing in four-row plots. Specific

hybrids used were Beck's 63X (Springfield), Beck's 51X (Wooster, 1987 and 1988), and Pioneer Brand 3475 (Wooster and Hoytville, 1989). Separate experiments in corn and soybean residues were conducted in 1987 at Wooster.Each year ear leaf samples were taken at silking for N and S analysis. Grain was machine-harvested from the center two rows of each plot following physiological maturity and yields corrected to a 15.5% moisture basis.

All data were interpreted using analysis of variance, including lsd and single degree of freedom comparisons for mean separation. Single degree of freedom tests were used to group yield effects by treatment class at Springfield and to evaluate yield trends with rate of S addition in 1988 and 1989.

RESULTS AND DISCUSSION

Corn grain yield and ear leaf S concentration were unaffected by N management practices and sulfur addition in 1987 at Springfield (Table 2). Average ear leaf N concentrations were greater when 100 lb N/A were applied by dribbling than broadcasting ($P<.05$); however, no differences were noted when 200 lb N/A were used. When corn followed corn at Wooster, yield increased slightly as N rate increased. Overall, ear leaf S concentrations were greater when ATS was applied. When corn followed soybeans at Wooster, yield for corn receiving broadcast N with ATS (averaged across rates) was lower than in other treatments. Ear leaf S concentrations were unaffected by ATS addition.

Grain yield was unaffected by N management or S addition at Wooster in 1988 (Table 3). Overall ear leaf N and S concentrations were somewhat greater when N was applied by dribbling rather than by broadcasting.

Corn receiving 100 lb N/A (with or without S) appeared to produce greater yield and show greater ear leaf N and S concentrations than corn receiving none in 1989 at both locations (Table 3). The 0 lb N/A check plots were not included in the formal statistical analysis. At Wooster increasing rates of ATS in the broadcast N treatments increased grain yield ($P<.05$, when yield was evaluated against S rate as a linear trend); however no other yield effects were noted. Yield was unaffected by S addition at Hoytville. Ear leaf N and S concentrations were unaffected by S treatment at both locations.

Overall, additions of ATS to UAN had mixed effects on corn performance. Examples of yield enhancement and depression were noted in this series of studies; however, the most common response was no effect. When effects were seen, they were not related to N or S nutrition as measured by ear leaf nutrient concentrations. The increased yield noted at Wooster in 1989 was not paralleled by a similar response when AS was the S source, indicating that this was not a simple S response. Measurements of soil ammonium-N and nitrate/nitrite-N (not reported) after application showed no consistent response to ATS addition. Whether consistent responses would be seen at greater ATS concentrations is open to speculation. One could logically question whether the rates of ATS used in this series of studies were great enough to produce consistent responses. Additional studies at greater ATS concentrations may be warranted.

Table 1. Study details for sulfur studies at Springfield, Hoytville and Wooster.

	1987		1988	1989	
	Springfield	Wooster	Wooster	Wooster	Hoytville
Tillage	No-till	No-till	No-till	No-till	Chisel
Previous crop+	SB	C & SB	C	C	OC
Residue cover (%)	30	80 & 30	80	80	5
Plot size (ft)	10x30	10x30	10x30	10x30	10x50
Plant date	4/24	5/9	5/4	5/19	5/15
N/S Application	4/24	5/9	5/13	5/31	5/30
N rate (lb/A)	100,200	100,200	150	100	100
S source	ATS	ATS	AS,ATS	AS,ATS	AS,ATS
S rate (lb/A)++	2 in 100 N 4 in 200 N	2 in 100 N 4 in 200 N	1,2,5,10	1,2,5,10	1,2,5,10
Application method	B,D	B,D	B,D	B,D	B,D

+ Previous crop - SB-soybean, C-corn, OC-oat cover crop
++ S source - ATS-ammonium thiosulfate, AS-ammonium sulfate
2% v/v mixtures in 1987

Table 2. Ammonium thiosulfate and N management effects on corn yield and ear leaf N and S concentrations at Springfield and Wooster in 1987.

N treatment[+] (rate/method)		Springfield			Wooster - after corn			Wooster - after soys		
		Yield	Leaf N	Leaf S	Yield	Leaf N	Leaf S	Yield	Leaf N	Leaf S
lb/A		bu/A	---- % ----		bu/A	---- % ----		bu/A	---- % ----	
0		140	2.47	0.19	-	-	-	-	-	-
100	B	180	2.72	0.19	138	2.95	0.21	167	3.38	0.24
100	BS	166	2.69	0.19	139	3.10	0.22	148	3.29	0.22
100	D	180	2.99	0.19	138	2.71	0.20	162	3.36	0.23
100	DS	179	2.93	0.19	142	2.88	0.21	165	3.33	0.23
200	B	184	2.82	0.19	145	3.31	0.23	161	3.36	0.22
200	BS	184	2.88	0.19	135	3.12	0.23	154	3.35	0.23
200	D	187	2.98	0.19	148	3.21	0.22	163	3.45	0.22
200	DS	182	2.90	0.19	139	3.14	0.23	172	3.34	0.23
$lsd_{.05}$										
N rate (R)					2	ns	ns	ns	ns	ns
Method (M)					ns	ns	ns	6	ns	ns
ATS (S)					ns	ns	0.006	ns	ns	ns
R x M					ns	ns	ns	ns	ns	ns
R x S					ns	ns	ns	ns	ns	ns
M x S					ns	ns	ns	7	ns	ns
R x M x S		ns	ns	ns	ns	ns	ns	ns	ns	ns

[+] Broadcast N (B), Dribbled N (D), ATS added (S)

Table 3. Ammonium sulfate (AS) and ammonium thiosulfate (ATS) effects on corn yield and ear leaf N and S concentrations at Wooster, 1988 and 1989, and Hoytville, 1989.

Location, year and S rate	N application method and S treatment											
	Grain yield				Ear leaf N				Ear leaf S			
	Broadcast		Dribbled		Broadcast		Dribbled		Broadcast		Dribbled	
	AS	ATS	AS	ATS	AS	ATS	AS	ATS	AS	ATS	AS	ATS
lb/A	------ bu/A ------				---------- % ----------							
Wooster-1988												
0	94		98		3.41		3.55		0.23		0.23	
1	95	105	96	96	3.47	3.51	3.47	3.47	0.22	0.23	0.24	0.23
2	100	96	96	90	3.43	3.42	3.50	3.55	0.22	0.22	0.24	0.24
5	93	98	98	93	3.50	3.43	3.40	3.59	0.23	0.23	0.23	0.24
10	101	90	94	97	3.40	3.55	3.53	3.65	0.24	0.23	0.24	0.24
$lsd_{.05}$												
Method	ns				0.06				0.008			
All others	ns				ns				ns			
Wooster-1989												
0 (No N)	59				1.59				0.16			
0	116		107		2.41		2.48		0.18		0.18	
1	124	127	112	114	2.40	2.57	2.41	2.46	0.17	0.18	0.19	0.19
2	115	115	122	113	2.48	2.45	2.57	2.41	0.17	0.19	0.19	0.18
5	113	132	114	99	2.59	2.51	2.43	2.28	0.19	0.18	0.19	0.17
10	121	140	111	108	2.44	2.40	2.45	2.33	0.18	0.18	0.19	0.18
Hoytville-1989												
0 (No N)	140				2.67				0.19			
0	154		158		2.86		2.86		0.21		0.21	
1	156	153	156	166	2.98	2.95	2.89	2.89	0.20	0.21	0.19	0.20
2	152	160	157	154	2.78	2.89	2.90	2.97	0.21	0.21	0.20	0.21
5	158	157	150	158	3.02	2.98	2.95	2.92	0.21	0.22	0.21	0.21
10	156	164	157	156	2.94	2.99	2.92	2.98	0.21	0.21	0.21	0.21

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