Seven-State Soybean Sulfur Fertilization Trials 2019 Summary

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Introduction

Many soybean growers are interested in the use of additional sulfur (S) to increase yields and profitability. However, with low profit margins, the effect of additional sulfur containing fertilizers on soybean yield and economic return is important to understand. In 2019, we began to evaluate some common sources of sulfur to help us identify environmental and soil factors where yield response to applied sulfur is most likely to occur.

Methods

Sulfur fertilization source and rate were tested in small plot trials at 19 locations in 7 states in 2019 (Figure 1). Two sources of S (AMS, ammonium sulfate, 21-0-0-24S and CaSO4, calcium sulfate, 0-0-0-17S) at four rates (0, 10, 20, 30 lbs S/a) along with a nitrogen check (urea, 46-0-0) were tested in a randomized complete block design at all sites (Table 1). Spring fertilizer treatments were hand-applied to soybean plots immediately after planting. Measured amounts of all fertilizers were broadcast over the already-planted rows. No soil incorporation was performed. Treatments were selected for their range of S levels. Several S containing fertilizers also included N, and comparison treatments with just N fertilizers were established for proper comparison and evaluation. Soybean grain was harvested and yield and grain composition were determined. Grain protein, oil, and amino acid concentrations were measured. Only sulfur containing amino acids were included in the statistical analysis this year. Trials will be conducted again in 2020.

Results

An analysis across all locations did not show any significant differences in yield. As most states only had one or two locations, a state-specific analysis was not specified. We examined the location x treatment effect and sliced the effects by location.

Figure 1. Map of 2019 sulfur fertilization sites

Table 1. List of products, application rates, and nutrients applied.

Treatment	Form	Product	Supplied S	Supplied N
		lbs/a	lbs/a	lbs/a
1	UTC		0	0
2	AMS	42	10	9
3	AMS	83	20	18
4	AMS	125	30	26
5	CaSO4	59	10	0
6	CaSO4	118	20	0
7	CaSO4	176	30	0
8	Urea	19	0	9
9	Urea	39	0	18
10	Urea	56	0	26

Yield

Of the 19 locations with trials in 2019, five were significant for yield differences due to fertilization treatment (Table 2.). There was no treatment that consistently increased yield and/or protein in every location.

Table 2. Yield of soybeans at five sites with significant differences. An asterisk (*) indicates value is not different from the highest value **(bolded)** at that location.

Product	Supplied S	Supplied N	Minnesota Lake MN	Starkville MS	Dunn NC	East Troy WI	Hancock WI
	lbs/a	lbs/a		----------bu/a ----------			
UTC	0	0	53.6	29.6 *	60.9 *	75.4 *	**74.8** *
AMS	10	9	64.7 *	32.3 *	64.7 *	**78.5** *	73.8 *
AMS	20	18	**68.6** *	**33.2** *	63.9 *	74.1 *	66.0 *
AMS	30	26	64.6 *	32.3 *	69.1 *	71.2 *	61.2
CaSO4	10	0	66.9 *	26.1	67.6 *	67.3 *	68.6 *
CaSO4	20	0	66.3 *	26.9	63.6 *	59.2	60.3
CaSO4	30	0	67.1 *	30.7 *	67.7 *	71.5 *	67.5 *
Urea	0	9	62.2 *	31.7 *	58.1	64.3	52.0
Urea	0	18	60.1 *	30.5 *	64.0 *	77.7 *	55.5
Urea	0	26	54.5	29.9 *	**69.5** *	75.0 *	66.7 *

Grain composition

Table 3 indicates grain protein and oil concentration and Table 4 indicates grain cysteine and methionine amino acid concentration at those locations that had significant differences. No discernable trends or differences were found across the 19 locations for any of these four values.

Table 3. Grain protein and oil concentration at the five sites that showed significant differences. An asterisk (*) indicates value is not different from the highest value **(bolded)** at that location.

Product	Supplied S	Supplied N	Lexington-1 KY	MN Lake MN		Chippewa Falls WI	East Troy WI		Hancock WI	
			Protein	Protein	Oil	Protein	Protein	Oil	Protein	Oil
	lbs/a	lbs/a	---------- % ----------							
UTC	0	0	39.1 *	37.8	**21.7** *	40.5 *	37.9 *	22.1 *	41.6 *	20.8 *
AMS	10	9	39.0 *	39.0 *	21.1 *	39.9 *	37.7 *	22.1 *	40.5	**21.1** *
AMS	20	18	**39.8** *	**39.3** *	21.1 *	39.7	37.0	22.2 *	41.3 *	20.7 *
AMS	30	26	38.4	38.9 *	21.0	**40.9** *	37.4 *	**22.6** *	40.7	20.7 *
CaSO4	10	0	39.1 *	38.9 *	21.2 *	40.2 *	37.5 *	22.1 *	41.0 *	20.6 *
CaSO4	20	0	38.9 *	39.0 *	21.2 *	40.5 *	36.8	22.4 *	40.8	20.9 *
CaSO4	30	0	38.4	39.0 *	21.2 *	40.6 *	36.8	22.5 *	40.5	20.9 *
Urea	0	9	38.7 *	37.8	**21.7** *	40.0 *	37.9 *	22.0 *	41.4 *	20.4 *
Urea	0	18	38.9 *	37.8	**21.7** *	40.7 *	38.0 *	22.2 *	**42.0** *	20.2
Urea	0	26	39.8 *	37.2	**21.7** *	39.5	**38.3** *	21.8	41.3 *	20.7 *

Table 4. Grain amino acids cysteine and methionine concentration at the five sites that showed significant differences. An asterisk (*) indicates value is not different from the highest value **(bolded)** at that location.

Product	Supplied S	Supplied N	Lexington-1 KY		MN Lake MN		Arlington WI		Chippewa Falls WI		Platteville WI
			Cys[+]	Met	Cys	Met	Cys	Met	Cys	Met	Cys
	lbs/a	lbs/a	---------- % ----------								
UTC	0	0	0.652 *	0.570 *	0.598	0.538	0.660	0.590 *	0.662 *	0.574 *	0.648 *
AMS	10	9	0.664 *	0.574 *	0.652 *	0.572 *	0.682 *	0.594 *	0.654 *	0.564 *	0.660 *
AMS	20	18	0.670 *	**0.586** *	0.658 *	0.570 *	0.672 *	0.592 *	0.648	0.562	0.662 *
AMS	30	26	0.642	0.566 *	**0.660** *	**0.574** *	**0.688** *	**0.600** *	0.670 *	0.580 *	0.656 *
CaSO4	10	0	0.654 *	0.570 *	0.642 *	0.564 *	0.684 *	0.592 *	0.648	0.564 *	0.654 *
CaSO4	20	0	0.662 *	0.574 *	0.658 *	0.572 *	0.680 *	0.596 *	0.662 *	0.576 *	0.650 *
CaSO4	30	0	0.650 *	0.570 *	0.648 *	0.564 *	**0.688** *	0.600 *	**0.674** *	**0.584** *	0.658 *
Urea	0	9	0.644	0.564	0.602	0.538	0.662	0.580 *	0.646	0.564 *	0.650 *
Urea	0	18	0.648 *	0.564	0.602	0.538	0.668 *	0.580 *	0.660 *	0.576 *	**0.666** *
Urea	0	26	**0.672** *	0.578 *	0.608	0.536	0.660	0.576	0.638	0.558	0.638

[+]Cys=Cysteine, Met=Methionine

Appendix 1. Soil test results for 19 locations.

State	Location	pH	OM	P	K	Ca	Mg	B	Mn	Zn	S
			%			---------- ppm ----------					
AR	Newport	6.4		116	125	767	129		195	4.4	12.2
AR	PineTree	6.8		22	90	1568	234		106	2.1	12.5
KY	Lexington-1	5.4	2.5	199	145	2447	334			8.2	
KY	Lexington-2	5.4	2.5	100	181	1798	181			1.4	
KY	Princeton	5.7	2.2	39	293	3657	165			2.8	
MN	Danvers	7.6	4.3	1	308						
MN	MN Lake	5.9	5.3	20	135						
MS	Starkville	7.7	2.4	31	130	8581	83	1.2	44	1.7	23.0
NC	Dunn	6.0	0.8	121	61	308	50	0.3	16	5.3	7.0
SD	South Shore	5.9	3.8	22	124	2423	682	1.0	36	0.4	10.5
WI	Arlington	7.1	3.4	58	144	1816	513	0.6	7	3.8	3.3
WI	Chippewa Falls	6.4	1.5	50	172	658	163	0.4	13	3.0	2.3
WI	East Troy	6.1	3.5	94	137	1801	375	0.5	7	3.9	2.3
WI	Fond du Lac	6.7	3.6	16	118	1928	504	0.5	8	2.3	7.8
WI	Galesville	6.3	3.1	36	189	1313	292	0.5	12	3.2	14.4
WI	Hancock	6.0	0.7	94	101	182	40	0.2	11	1.2	1.0
WI	Marshfield	6.7	3.7	31	193	1150	347	0.4	25	2.3	6.5
WI	Platteville	6.5	2.8	26	117	1433	447	0.3	8	6.6	2.0
WI	Seymour	7.1	2.4	20	128	1269	255	0.4	10	1.6	4.2