

Title: Effect of nitrogen and sulfur on winter and spring wheat.

Year: 2003.

Locations: (1) Southwest of Conrad, MT on the Greg Kellogg farm  
(2) East of Brady, MT (Knees) on the Dan Picard farm  
(3) East of Sunburst, MT on the Herb Karst farm

Personnel:

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Objectives:

To determine wheat yield and protein response to nitrogen (N) fertilization and N soil tests and sulfur (S) fertilizer and S soil tests.

Procedures:

Nitrogen fertilizer treatments of 0, 30, 60 and 90 lbs (0, 50, 100, and 150 lbs on spring wheat) N/acre were applied in combination with sulfur fertilizer rates of 0, 10, 20, and 30 lbs S/acre. All fertilizer materials were applied while planting, and all plots received the P and KCl fertilizers. Nitrogen as urea (46-0-0) and potash (30 lbs KCl/acre as 0-0-60) fertilizers were broadcast, P (60 lbs/acre of monoammonium phosphate was placed with the seed, and S as ammonium thiosulfate (12-0-0-26) was dribbled on the surface approximately two inches from the seed row. Both plot areas were planted into chemical-fallow (spring wheat-recrop into barley stubble) using a six-row, double disk plot drill with 12 inch row spacing. Planting rates were 20 seeds/ft<sup>2</sup>, and the cultivar was Rampart. Plot size was 6 by 25 feet with four replications. Plots were harvested with a Hege plot combine.

Results:

Grain yield, grain protein content, test weight, and seed S content are shown in Tables 57s, 58s, and 59s. The Kellogg location (Table 57s) did not respond to N or S fertilizer; however, the results were highly variable as the result of the drought conditions and shallow soils. The Picard location (Table 58s) responded to both N and S fertilizers. This is the first, documented winter wheat yield and protein response to S in the Western Triangle area. The N and S grain yield and protein responses were very dramatic and classic, text book responses to two added nutrients without interaction. The S response was probably due to previous year's dry conditions and the subsequent lack of sulfate dissolution from the mineral gypsum which is prevalent in Western Triangle soils. In the spring wheat experiment (Table 59s), all responses (yield, protein, test weight, and grain S content) were due to N. Interestingly, S content of the grain was not increased by S fertilization.

Table 57s. Effect of N and S on winter wheat yield and quality. Experiment located Southwest of Conrad, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	31.7	14.5	58.6	0.174
0-10	31.4	14.6	58.2	0.174
0-20	34.1	12.9	59.4	0.163
0-30	35.5	14.8	58.3	0.182
30-0	32.9	12.9	59.3	0.160
30-10	31.1	11.6	60.0	0.149
30-20	30.9	12.6	59.3	0.160
30-30	30.3	13.5	58.7	0.167
60-0	29.3	15.6	57.1	0.191
60-10	32.7	14.3	58.1	0.177
60-20	31.0	14.3	57.9	0.174
60-30	30.0	14.1	58.5	0.168
90-0	31.7	13.7	58.2	0.164
90-10	31.1	14.7	57.9	0.183
90-20	34.4	14.2	59.2	0.181
90-30	32.9	15.2	58.0	0.181

#### Summary Statistics

Experimental Means	31.9	14.0	58.5	0.172
Interaction P-value	0.478	0.775	0.763	0.428
C.V. 1: (s/mean)*100	10.5	13.3	2.5	10.9

#### Nitrogen Summary

0	33.2	14.2	58.6	0.173
30	31.3	12.7	59.3	0.159
60	30.7	14.6	57.9	0.178
90	32.5	14.4	58.3	0.177
P-value	0.175	0.022	0.062	0.026
Linear Contrast	0.519	0.212	0.178	0.156
Quadratic Contrast	0.036	0.135	0.715	0.143
LSD (0.05)	NS	NS	NS	0.013

### Sulfur Summary

0	31.4	14.2	58.3	0.172
10	31.6	13.8	58.5	0.171
20	32.6	13.5	59.0	0.170
30	32.2	14.4	58.4	0.174
P-value	0.738	0.553	0.586	0.896
Linear Contrast	0.383	0.894	0.681	0.804
Quadratic Contrast	0.722	0.187	0.270	0.494
LSD (0.05)	NS	NS	NS	NS

### Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	----- ppm -----		mmhos/cm	%	
0 - 6"	298	13.0	0.24	3.06	8.0
Depth			NO <sub>3</sub> -N	SO <sub>4</sub> -S	
(ft)			----- (lbs/a) -----		
0 - 1			22.1	45.2	
1 - 2			2.18.3	29.5	

Notes:

Variety: Rampart

Seeding Date: 9/12/02

Growing Season ppt: 1.50"

Previous Crop: Chemical Fallow

Herbicide: None.

Harvest Date: 7/29/03

Planting Rate: 20 seeds/ft<sup>2</sup>

Table 58s. Effect of N and S on winter wheat yield and quality. Experiment located East of Brady (Knees community), MT. Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer Rate N-S (lbs/ac)	Grain Yield (bu/ac)	Protein Content %	Test Weight (lb/bu)	Sulfur Content (%)
0-0	40	13.6	58.5	0.170
30-0	42.2	13.8	58.2	0.168
60-0	44.3	14.4	58.1	0.176
90-0	45.2	14.5	57.6	0.178
0-10	46.6	13.9	59.0	0.167
30-10	48.4	14.3	58.6	0.170
60-10	49.4	15.1	58.3	0.180
90-10	49.5	15.0	58.5	1.178
0-20	48.8	14.3	58.4	0.169
30-20	48.9	14.2	58.7	0.173
60-20	51.7	15.3	58.2	0.178
90-20	53.1	15.5	58.6	0.197
0-30	49.4	14.7	58.2	0.179
30-30	50.0	15.5	58.1	0.198
60-30	52.7	15.8	57.9	0.192
90-30	52.1	16.7	57.4	0.201

#### Summary Statistics

Experimental Means	48.2	14.8	58.3	0.180
Interaction P-value	0.983	0.869	0.983	0.636
C.V. 1: (s/mean)*100	6.1	5.2	1.2	7.3

#### Nitrogen Summary

0	46.2	14.1	58.6	0.171
30	47.3	14.4	58.4	0.177
60	49.5	15.1	58.1	0.181
90	50.0	15.4	58.0	0.188
P-value	0.002	0.000	0.063	0.005
Linear Contrast	0.000	0.000	0.008	0.000
Quadratic Contrast	0.641	0.963	0.714	0.842
LSD (0.05)	2.1	0.5	NS	0.009

### Sulfur Summary

0	42.9	14.1	58.1	0.173
10	48.4	14.6	58.6	0.174
20	50.6	14.8	58.5	0.179
30	51.0	15.7	58.0	0.193
P-Value	0.000	0.000	0.034	0.000
Linear Contrast	0.000	0.000	0.646	0.000
Quadratic Contrast	0.000	.0358	0.004	0.064
LSD (0.05)	2.1	0.5	0.5	0.009

### Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	----- ppm -----		mmhos/cm	%	
0 - 6"	456	20.8	0.25	1.85	8.0
Depth		NO <sub>3</sub> -N		SO <sub>4</sub> -S	
(ft)		----- (lbs/a) -----			
0 - 1		32.1		178.6	
1 - 2		18.8		120.4	
2 - 3		38.4		2719.5	
3 - 4		32.2		6635.0	
4 - 5		13.5		8530.6	

Notes:

Variety: Rampart

Seeding Date: 9/13/02

Harvest Date: 7/29/03

Growing Season ppt: 0.82"

Planting Rate: 20 seeds/ft<sup>2</sup>

Previous Crop: Winter Wheat Chemical fallow

Herbicide: None

The rain gauge was not put out until most of the June moisture was past.

Table 59s. Effect of N and S on spring wheat yield and quality. Experiment located East of Sunburst, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	24.3	10.8	58.3	0.157
0-10	24.4	10.9	58.0	0.157
0-20	22.7	10.9	58.2	0.163
0-30	22.2	10.6	58.6	0.161
50-0	34.4	12.8	57.3	0.177
50-10	35.0	12.7	57.4	0.177
50-20	30.4	13.0	56.5	0.180
50-30	32.2	12.2	58.1	0.175
100-0	33.5	16.0	55.2	0.206
100-10	39.2	15.0	56.1	0.197
100-20	41.3	14.7	56.9	0.203
100-30	36.5	15.2	56.2	0.210
150-0	34.0	17.3	54.6	0.230
150-10	38.6	16.5	55.5	0.224
150-20	35.6	16.8	55.0	0.229
150-30	35.0	17.0	54.5	0.230

#### Summary Statistics

Experimental Means	32.5	13.9	56.7	0.192
Interaction P-value	0.613	0.885	0.678	0.999
C.V. 1: (s/mean)*100	16.5	7.7	2.4	8.6

#### Nitrogen Summary

0	23.4	10.8	58.3	0.160
50	33.3	12.7	57.3	0.177
100	37.7	15.2	56.1	0.204
150	35.8	16.9	54.9	0.228
P-value	0.000	0.000	0.000	0.000
Linear Contrast	0.000	0.000	0.000	0.000
Quadratic Contrast	0.000	0.743	0.708	0.424
LSD (0.05)	3.8	0.8	1.0	0.012

### Sulfur Summary

0	31.6	14.2	56.3	0.192
10	34.3	13.7	56.8	0.189
20	32.3	13.9	56.6	0.194
30	32.0	13.8	56.9	0.194
P-value	0.491	0.565	0.744	0.811
Linear Contrast	0.880	0.291	0.361	0.600
Quadratic Contrast	0.263	0.483	0.777	0.649
LSD (0.05)	NS	NS	NS	NS

### Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	----- ppm -----		mmhos/cm	%	
0 - 6"	393	26	0.88	1.7	7.4
Depth (ft)			NO <sub>3</sub> -N	SO <sub>4</sub> -S	
			----- (lbs/a) -----		
0 - 1			9	66	
1 - 2			4	328	
2 - 3			4	449	
3 - 4			4	662	
4 - 5			4	585	

Notes:

Variety: McNeal

Seeding Date: 4/23/03

Growing Season ppt: 2.7"

Previous Crop: Chemical Fallow

Herbicide: Applied Bronate at 1½ pt/a and Discover at 4 oz/a on 5/29/03.

Harvest Date: 8/11/03

Planting Rate: 20 seeds/ft<sup>2</sup>