Foliar Micronutrients, Growth Regulator, Lime and High-Rate Calcium Applications for Alfalfa Production

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Summary and Implications

Seven treatments applied to alfalfa were compared to evaluate their effect on profitable alfalfa production. Other than meeting the lime requirement based on ISU soil test recommendations, no other treatment added profitability. Research is still limited on defining soil test and plant analysis levels to provide a reasonable probability of an economic return to Boron fertilization of alfalfa.

Introduction

Persistent salesmanship in the private sector on the use of micronutrients, growth regulators, or high rates of calcium for alfalfa production spurred interest from the Northeast Iowa Agricultural Experimental Association to conduct a research trial with some of these products.

Materials and Methods

The research site was cropped to soybeans in 2010 and direct seeded to alfalfa in 2011 at 15 lb/acre with a Brillion seeder. All treatments received P, K and S fertilizer at ISU recommended rates to maintain optimal fertility levels. All but two treatments received lime. The two high-rate Ca treatments received 1,000 lb/acre of $CaSO_4$ each year including 2011 prior to seeding.

The treatments were: (1) No lime; (2) Lime; (3) Lime plus 1,000 lb/acre $CaSO_4$; (4) No lime plus 1,000 lb/acre $CaSO_4$; (5) Lime plus 3 pints/acre MAX-IN® Ultra ZMB® foliar applied at a 6 to 8-inch canopy height; (6) Treatment 5 plus 1.2 pints/acre MAX-IN® Boron; (7) Treatment 6 plus 3.2 ounces/acre ASCEND®.

In 2012 and 2013, the trial was harvested four times per year with a flail chopper. Composite samples were tested for plant analyses and forage quality on first and third harvests. Insect pests were controlled on all plots.

Results and Discussion

Alfalfa yield by harvest within treatments were similar for 2012 and 2013, with average harvest yields by treatments provided in Table 1. Total yield showed limed treatments with higher yields than non-limed treatments, with Treatment 2 being the most profitable. Applications of micronutrients, Ascend, or high rates of calcium did not affect forage yield.

Soil test results in Tables 2 and 3 include optimum levels suggested by ISU and the University of Wisconsin. Only Boron (B) was deficient. Plant analysis showed B deficiency in third harvest, but not first harvest (Tables 4 and 5). Availability and uptake of some nutrients can be affected by different environments. One would assume a foliar application of B would correct this deficiency and provide a yield response. However, while B applications increased B plant analysis, there was no yield response. Even so, when B deficiencies are assumed from proper soil or plant testing, a B application may be warranted.

The only other nutrient of concern was Mg, with marginally low plant analysis levels in first harvest. Low Mg levels in feed could contribute to Tetany. It is common to find lower Mg levels in forages growing in cool environments, but as long as forage is tested, livestock nutritionists can appropriately adjust rations.

Table 1. Forage yield and calculated profit/acre/year compared to ISU recommendations denoted by Treatment 2.

	Harvest (average for 2012 and 2013)				Total	Total value	Treatment	Gross	Profit/ac/yr
Trt	1st	2nd	3rd	4th	yield	at $150/ton	costs[a]	profit	vs. Trt 2
	ton/ac					$/ac			
1	2.22 a	1.64 a	1.42 a	1.35 ab	6.63 a	995	0	995.00	-$14.00 b
2	2.26 a	1.73 b	1.45 a	1.39 ab	6.83 b	1,025	16.00	1009.00	0.00 a
3	2.21 a	1.63 a	1.40 a	1.34 a	6.58 a	987	50.00	937.00	-$72.00 e
4	2.27 a	1.74 b	1.43 a	1.39 ab	6.83 b	1,025	66.00	959.00	-$50.00 d
5	2.23 a	1.75 b	1.44 a	1.42 b	6.84 b	1,026	48.00	978.00	-$31.00 c
6	2.27 a	1.73 b	1.46 a	1.41 ab	6.87 b	1,031	59.00	972.00	-$37.00 c
7	2.24 a	1.75 b	1.47 a	1.41 ab	6.87 b	1,031	81.40	949.60	-$59.40 d
$LSD^{b}_{0.05}$	0.11	0.09	0.08	0.08	0.19				10.20

[a]Treatment costs/harvest: Lime prorated at $4/ac; 1,000 lbs CaSO4 prorated at $12.50/ac; MAX-IN® Ultra ZMB® $8.00/acre; MAX-IN® Boron $2.75/acre; ASCEND® $5.60/acre; Foliar application $6.00/acre.

[b]LSD = Least significant difference. Differences by one LSD or more are significant with 95 percent certainty.

Table 2. Soil test levels of treatments in 2012.

Trt	pH	buffer	P	K	S	Ca	Mg	Zn	B
					ppm				
1	6.1	6.7	24	152	6.7	1910	270	5.4	0.4
2	6.9	- -	22	180	6.7	2410	250	5.5	0.4
3	5.8	6.7	26	162	6.7	2100	260	5.4	0.4
4	6.6	- -	25	195	5.8	2040	290	5.3	0.4
5	6.5	6.9	29	154	7.5	2430	280	5.1	0.4
6	6.6	- -	29	166	6.7	2480	260	5.3	0.3
7	6.6	- -	26	150	8.3	2540	270	5.4	0.3
Opt	6.6-		21-	161-		600-	101-	>0.9	0.9
levels	6.9		25	200		1000	500		1.5
Source	IA	IA	IA	IA		WI	WI	IA	WI

Table 3. Soil test levels of treatments in 2013.

Trt	pH	buffer	P	K	S	Ca	Mg	Zn	B
					ppm				
1	5.8	6.7	31	200	3.8	1860	230	2.3	0.7
2	6.5	7.0	33	187	5.0	2270	220	2.2	0.5
3	5.6	6.7	31	176	6.5	2160	180	2.2	0.7
4	6.4	7.0	34	182	5.0	2480	170	2.0	0.5
5	6.4	7.0	32	181	6.7	2320	230	2.4	0.8
6	6.5	7.0	31	196	5.0	2120	200	2.4	0.7
7	6.5	7.0	34	176	5.8	2150	200	2.2	0.8
Opt	6.6-		21-	161-		600-	101-	>0.9	0.9
levels	6.9		25	200		1000	500		1.5
Source	IA	IA	IA	IA		UW	UW	IA	UW

Table 4. Plant analysis, first harvest, 2012 and 2013.

Trt	N	P	K	S	Ca	Mg	Zn	B
				%			ppm	
2012								
1	4.5	0.33	2.33	0.34	1.42	0.19	33.0	24.7
2	4.5	0.32	2.32	0.36	1.43	0.19	29.5	30.8
3	4.2	0.31	2.24	0.38	1.39	0.18	32.9	24.9
4	4.5	0.32	2.39	0.37	1.38	0.17	28.9	29.8
5	4.4	0.34	2.25	0.33	1.33	0.18	36.7	25.1
6	4.4	0.33	2.36	0.34	1.40	0.18	37.7	30.4
7	4.3	0.33	2.24	0.33	1.37	0.19	35.5	30.0
2013								
1	4.6	0.37	2.58	0.33	1.39	0.21	32.8	34.2
2	4.4	0.38	2.72	0.31	1.29	0.22	34.5	37.4
3	4.5	0.38	2.69	0.37	1.36	0.22	30.7	39.2
4	4.5	0.37	2.71	0.33	1.24	0.20	34.5	29.3
5	4.3	0.37	2.47	0.35	1.29	0.23	32.1	33.5
6	4.3	0.37	2.61	0.33	1.29	0.22	35.9	39.7
7	4.4	0.38	2.79	0.35	1.32	0.22	41.7	42.7
Opt levels	2.5-4.0	0.26-0.45	2.26-3.40	0.26-0.50	0.7-2.5	0.26-0.70	20-60	26-60

Table 5. Plant analysis, third harvest, 2012 and 2013.

Trt	N	P	K	S	Ca	Mg	Zn	B
				%			ppm	
2012								
1	4.9	0.36	2.18	0.40	1.57	0.31	43.6	12.8
2	4.9	0.35	2.37	0.45	1.78	0.26	36.0	13.1
3	4.7	0.37	2.21	0.42	1.58	0.27	44.2	10.7
4	5.0	0.37	2.44	0.44	1.62	0.25	36.8	11.0
5	4.9	0.37	2.45	0.46	1.70	0.28	63.2	14.1
6	4.4	0.39	2.53	0.43	1.54	0.27	66.4	20.3
7	4.9	0.34	2.48	0.41	1.57	0.26	55.1	18.3
2013								
1	5.9	0.45	2.58	0.44	1.69	0.31	31.9	24.9
2	6.0	0.46	2.42	0.47	1.48	0.29	41.2	25.6
3	5.9	0.47	2.82	0.51	1.57	0.26	38.1	25.9
4	5.9	0.47	2.68	0.47	1.62	0.30	38.1	23.2
5	5.8	0.46	2.75	0.46	1.64	0.28	40.4	24.7
6	6.1	0.50	2.73	0.47	1.55	0.30	46.0	30.7
7	5.9	0.48	2.45	0.45	1.56	0.29	43.6	32.4
Opt levels	2.5-4.0	0.26-0.45	2.26-3.40	0.26-0.50	0.7-2.5	0.26-0.70	20-60	26-60

Table 6. Forage quality, first harvest, 2012 and 2013.

Trt	CP	RFV	P	K	S	Ca	Mg
	%				%		
2012							
1	20.1	140	0.36	2.34	0.24	1.41	0.23
2	21.4	147	0.38	2.98	0.25	1.43	0.24
3	20.9	141	0.39	2.76	0.26	1.40	0.23
4	20.9	143	0.38	2.25	0.26	1.40	0.25
5	19.1	131	0.36	2.48	0.24	1.37	0.25
6	19.0	131	0.37	2.75	0.24	1.39	0.27
7	19.2	136	0.38	2.50	0.25	1.42	0.26
2013							
1	20.4	117	0.35	3.37	0.24	1.33	0.27
2	21.9	127	0.38	3.60	0.25	1.33	0.29
3	21.2	126	0.36	3.30	0.24	1.35	0.28
4	22.1	127	0.36	3.45	0.25	1.38	0.30
5	19.8	120	0.34	3.46	0.24	1.35	0.27
6	21.0	130	0.36	3.13	0.25	1.35	0.28
7	21.4	129	0.37	3.41	0.26	1.33	0.28

Table 7. Forage quality, third harvest, 2012 and 2013.

Trt	CP	RFV	P	K	S	Ca	Mg
	%				%		
2012							
1	23.5	167	0.39	2.17	0.31	1.58	0.30
2	24.3	174	0.40	2.15	0.33	1.64	0.34
3	23.2	163	0.39	1.94	0.30	1.48	0.33
4	23.8	173	0.39	2.08	0.32	1.58	0.32
5	23.0	170	0.38	1.97	0.32	1.55	0.32
6	23.6	172	0.39	2.04	0.32	1.50	0.31
7	23.1	175	0.38	2.06	0.35	1.68	0.36
2013							
1	24.4	159	0.39	3.39	0.32	1.47	0.31
2	25.8	173	0.41	3.59	0.35	1.51	0.32
3	24.4	156	0.39	3.51	0.25	1.47	0.30
4	25.0	173	0.42	3.43	0.33	1.42	0.31
5	24.7	163	0.39	3.45	0.31	1.40	0.29
6	24.8	162	0.41	3.58	0.32	1.44	0.30
7	24.5	159	0.39	3.70	0.30	1.49	0.29