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Corn, Soybeans, and Soil Test Response to Lime and Hoop Building Manure in 2008

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Abstract
In 1995, a liming study was initiated at the Armstrong Farm where acid topsoil had developed from extensive nitrogen (N) fertilizer use for continuous corn (CC) production without liming. In 2003, the experimental area was divided into thirds; a corn–soybean (CSb) rotation occupies two-thirds of the area for equal areas of corn and soybean test crops and CC continues to occupy the remaining third. Hoop building cattle manure treatments were incorporated into the experiment beginning in 2006 to evaluate soil acidity effects on nutrient utilization by crops in both rotations and also on soil test values. In preparation for the 2008 crop year, manure was applied in the fall of 2007 where corn and soybeans would be grown in 2008.

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Introduction

In 1995, a liming study was initiated at the Armstrong Farm where acid topsoil had developed from extensive nitrogen (N) fertilizer use for continuous corn (CC) production without liming. In 2003, the experimental area was divided into thirds; a corn–soybean (CSb) rotation occupies two-thirds of the area for equal areas of corn and soybean test crops and CC continues to occupy the remaining third. Hoop building cattle manure treatments were incorporated into the experiment beginning in 2006 to evaluate soil acidity effects on nutrient utilization by crops in both rotations and also on soil test values. In preparation for the 2008 crop year, manure was applied in the fall of 2007 where corn and soybeans would be grown in 2008.

Material and Methods

Soil testing conducted in 1994 indicated that the amount of lime required to raise soil pH to 6.5 in this area was 15,000 lb/acre of effective calcium carbonate equivalent (ECCE). In April 1995, aglime was applied to maintain an unlimed control and to achieve target pHs of 5.5, 6.0, 6.5, and 7.0. Hoop building cattle manure with a moisture content of 70% was applied in the fall of 2007 at an application rate of 23 wet tons/acre. No tillage was done until spring. In the spring, light tillage was done, corn and soybeans were planted, and herbicides applied. No other in-season cultivation was done. Corn and soybeans were harvested with grain weights and moisture content recorded on the combine.

Results and Discussion

Table 1 presents soil pHs, SMP buffer pHs, and ECCE requirements to achieve soil pHs 6.5 or 6.9 of soil samples taken after harvest and to a depth of 6 inches. Although two pH values are reported, SMP pHs are used to determine ECCE requirements; pH values alone indicate the severity of acidity. Recommended ECCEs are for the upper 6 in. of soil. The SMP solution has a pH of 7.5; its value decreases when shaken with soil as acidic ions are released. The measured SMP pH is calibrated to the ECCE needed to adjust soil pH to values of 6.5 and 6.9 for row crops and alfalfa production, respectively.

A summary of soybean data by treatments and simple statistics are presented in Table 2. Soybean moisture content was generally unaffected by lime but it increased when manure was applied. Increasing aglime application increased grain yield with maximums occurring with the five-ton rate. A yield decline was noted at the 15- and 45-ton limestone rates for unmanured plots and at the 45-ton rate for manured plots. The overall effect of manure was to increase soybean moisture content 0.3% and yield by 1.5 bushels/acre.

Table 3 shows corn responses to liming, N-rate, rotation with soybeans, and manure treatment. Grain moisture content was consistently less in rotation where no aglime was applied and greater where it was applied. Where aglime was applied, CC moisture was greater when grown in rotation. The greater N-rate increased moisture content but not as greatly as manure. Where manure was applied, CC and rotation corn had nearly equal moisture contents at harvest. Corn grain yields generally were increased by increasing lime

applications up to the 5- and 15-tons rates for corn grown in rotation or with manure. Except for the check, CC yields were greatest at the 5- and 15-ton aglime rates. The overall yield increase from rotation when N-rate was increased from 150 to 200 lb/acre was 18 and 26 bushels/acre, respectively.

Manure application was beneficial to both corn and soybeans. Soybean and corn grain moisture contents, an indication of plant maturity, was increased by aglime at all but the 0-rate of aglime, which did not increase corn grain moisture content. At all other aglime rates, N-rates, and manure application increased grain moisture content. Corn yield responses to aglime were unique within aglime and rotation treatments.

The 2008 crop year marked the termination for fieldwork on this experiment by the author. Analyses are being completed on soils and stalk tissue collected in 2008 for more detailed analsyes in another report. Compilation and analysis of these data are intended to demonstrate the status of soil fertility resulting from manure application and no manure application and suggest how to best use aglime and cattle manure in southwest Iowa.

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Table 1. Soil pHs determined on 6-in. cores collected after harvest in 2008.

Aglime[a]	pH	SMP[b] pH	6.5 target	6.9 target
Tons/acre			ECCE[c] lb/acre	
0	5.74	6.35	3411	5911
1 2/3	6.00	6.45	2930	5367
5	6.27	6.64	1447	3691
15	7.00	6.96	-649	1323
45	7.29	7.09	-1641	203
Simple statistics				
Maximum	7.61	7.22	5713	8512
Minimum	5.35	6.10	-2511	-780
Average	6.15	6.61	1084	3282
Standard deviation	0.64	0.32	2367	2674

[a]Aglime applied in 1995.
[b]Smith, McLean and Pratt buffer pH.
[c]Effective calcium carbonate.

Table 2. Soybean responses to lime and nitrogen rates and manure in 2008.

Aglime[1]	No manure	Manure	Manure difference	No manure	Manure	Manure difference
Tons/acre	----- Grain moisture, percent -----			----- Grain yield, bushels/acre -----		
0	11.4	11.8	0.4	57.8	60.8	3.0
1 2/3	11.5	11.9	0.4	58.3	59.9	1.6
5	11.4	11.8	0.4	59.7	59.0	-0.7
15	11.6	11.8	0.2	55.4	59.0	3.6
45	11.4	11.7	0.4	57.4	57.1	-0.2
Simple statistics						
Maximum	12.4	12.0	0.6	64.5	64.1	19.3
Minimum	11.3	11.5	-0.8	41.2	54.7	-5.9
Average	11.5	11.8	0.3	57.7	59.2	1.5
Standard deviation	0.2	0.1	0.3	5.5	2.7	6.1

[1]Aglime applied in 1995.

Table 3. Corn responses to lime and nitrogen rates and manure in 2008.

Aglime[1]	Continuous	CSb rotation	Rotation difference	Continuous	CSb rotation	Rotation difference
tons acre	----- Grain moisture, percent -----			----- Grain yield, bushels/acre -----		
150 lb N/acre						
0	19.0	18.6	-0.4	189	219	30
1 2/3	18.0	19.2	1.2	192	208	16
5	18.1	18.4	0.3	198	206	8
15	18.1	18.2	0.1	195	219	23
45	17.7	18.0	0.2	200	211	10
Average	18.2	18.5	0.3	195	213	18
200 lb N/acre						
0	19.0	18.8	-0.2	197	221	24
1 2/3	18.6	18.9	0.3	187	212	25
5	18.5	18.7	0.2	179	215	36
15	18.2	18.5	0.3	195	223	28
45	17.8	18.2	0.4	200	219	19
Average	18.4	18.6	0.2	192	218	26
manure						
0	19.7	19.4	-0.4	224	222	-2
1 2/3	19.4	19.6	0.2	208	210	2
5	19.5	19.5	0.0	215	211	-4
15	19.1	19.2	0.1	210	220	10
45	19.0	19.3	0.2	206	212	6
Average	19.3	19.4	0.0	213	215	2
Simple statistics						
Maximum	20.2	20.0	1.7	233	244	52
Minimum	17.6	17.8	-1.7	168	193	-16
Average	18.6	18.8	0.2	200	215	15
Standard deviation	0.7	0.6	0.6	14	12	17

[1]Aglime applied in 1995.