

SOIL/WATER RESEARCH
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Soil pH influence and tillage influence on soybean and corn grain yield near Aurora SD in 2008. (28108 and 28208)

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Introduction

Nitrogen applications eventually lead to soil pH reductions due to the free H⁺ ion release during nitrification. While many years of nitrogen applications don't significantly reduce soil pH, the continued use of nitrogen fertilizers will gradually reduce soil pH to levels where management decisions need to be made. Soil

type also influences the rate of soil pH decline since the amount of available cations that can buffer H⁺ ions are different between soils. Therefore, a research site near Aurora SD was identified that had low soil pH in 1998. Two liming materials were applied along with a check (no lime) to evaluate their effect on soil pH and crop productivity. This study ended in 2006 and new objectives for this site were identified. Because the soil pH had been manipulated on some treatment plots and not others, it was decided to set up a range of soil pH levels and determine the effect of soil pH on crop productivity.

Materials and Methods

| Item: | Description: |
|---|--|
| Location | Crop Improvement Farm near Aurora SD |
| Crop Rotation | 2 sites, 2 crops (Corn/Soybeans) |
| Treatments (surface broadcast, tilled in on CT plots) (applied prior to planting and tillage) (Elemental S and Lime are totals applied) | Check - no soil amendment Elemental S (5000 lbs/a) to lower soil pH 8 tons lime/a applied during 1998 to 2006 4 tons lime/a (total) of this study |
| Tillage methods | CT = conventional tillage (fall chisel, spring field cultivate) NT = no-till |
| Soybean variety and seeding rate | Asgrow 1401 RR, (180,000 seeds/a) |
| Corn hybrid and seeding rate | Dekalb 46-60 (30,00 seeds/a) |
| Planting dates | Corn=(May 15) Soybean (June 2) |
| Plot size | 15 x 40 ft with 5' buffer areas between plots |
| Harvest date | Corn=(Nov. 3) Soybeans=(Oct. 1) |
| Soil samples from each plot (post harvest) | 0-2, 2-4, 4-6, and 6-12 inches |
| Statistics | SAS, RCBD with tillage main blocks |

Results and Discussion

Post harvest soil samples were not obtained from the soybean study (Tables 2 and 4). These samples will be obtained prior to planting in 2009. Therefore, soil pH data on table 2 is from 2006 and 2007 growing seasons. Soil pH (0-6 inch) is significantly different in the check plots when compared to the treated plots (Tables 1 and 2). For the 2008 corn study, soil pH (0-6

inch) dropped in the check and elemental S treatments from Nov. 2007 to Nov. 2008. Shallower soil sample depths do show the influence of the elemental S and additional lime application treatments (Table 3). The effects of the additions are probably not yet complete. Soil pH change is not instantaneous, so this may take a few years to develop a soil pH range. Corn and soybean grain yields were not significantly influenced by soil pH (Tables 1 and

2). Higher corn yield trends with increased soil pH were evident. Overall no-till soybean yield was significantly ($Pr>F = 0.05$) lower when compared with conventional tillage (CT=34.2 bu/a compared to NT=29.3 bu/a). Overall mean corn grain yields were not significantly

influenced by tillage ($Pr>F = 0.25$, CT=113.1 and NT=118.6 bu/a).

Acknowledgments

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Table 1. Influence of soil pH amendments on soil pH and corn grain yield near Aurora SD in 2008. (28108)

| Treatments ^A | | Conventional Tillage | | | No-Till | | |
|-------------------------|----------------|-----------------------------|-----------------------------|----------------|-----------------------------|-----------------------------|----------------|
| | | Nov. '07 0-6" soil pH | Nov. '08 0-6" soil pH | Grain Yield | Nov. '07 0-6" soil pH | Nov. '08 0-6" soil pH | Grain Yield |
| '98-'06 | '07-'08 | | | | | | |
| tons / a | | -log[H ⁺] | | bu/a | -log[H ⁺] | | bu/a |
| 0 | 0 | 5.6 b | 5.3 c | 102.3 | 5.5 c | 5.5 c | 107.9 |
| 8 lime | 2.5 elem. S | 7.1 a | 6.7 b | 117.9 | 6.5 b | 6.3 b | 112.4 |
| 8 lime | 0 | 6.9 a | 7.5 a | 118.1 | 6.8 a | 6.7 ab | 128.1 |
| 8 lime | 4 lime | 7.2 a | 6.9 ab | 114.1 | 6.9 a | 7.1 a | 125.8 |
| LSD _(.10) | | 0.4 | 0.7 | NS | 0.2 | 0.5 | NS |
| Pr>F | | 0.01 | 0.01 | 0.30 | 0.01 | 0.01 | 0.12 |

^A 1998 to 2006 treatment plots were managed for increased pH over the check. Since the project ended in 2006, new objectives were determined to change soil pH into a range for yield response. Therefore, one original lime treatment received elemental S to reduce soil pH, another left as is and the last to further increase soil pH through additional liming. Treatments applied prior to tillage and planting.

Table 2. Influence of soil pH amendments on soil pH and soybean grain yield near Aurora SD in 2008. (28108)

| Treatments ^A | | Conventional Tillage | | | No-Till | | |
|-------------------------|----------------|-----------------------------|-----------------------------|----------------|-----------------------------|-----------------------------|----------------|
| | | Nov. '06 0-6" soil pH | Nov. '07 0-6" soil pH | Grain Yield | Nov. '06 0-6" soil pH | Nov. '07 0-6" soil pH | Grain Yield |
| '98-'06 | '07-'08 | | | | | | |
| tons / a | | -log[H ⁺] | | bu/a | -log[H ⁺] | | bu/a |
| 0 | 0 | 5.7 b | 5.8 c | 34.3 | 5.7 b | 5.8 b | 27.9 |
| 8 lime | 2.5 elem. S | 6.9 a | 7.1 b | 37.5 | 6.4 a | 6.7 a | 30.1 |
| 8 lime | 0 | 7.0 a | 7.3 ab | 32.9 | 6.5 a | 6.8 a | 27.9 |
| 8 lime | 4 lime | 7.2 a | 7.5 a | 32.0 | 6.6 a | 7.1 a | 31.1 |
| LSD _(.10) | | 0.5 | 0.3 | NS | 0.2 | 0.6 | NS |
| Pr>F | | 0.01 | 0.01 | 0.21 | 0.01 | 0.03 | 0.70 |

^A 1998 to 2006 treatment plots were managed for increased pH over the check. Since the project ended in 2006, new objectives were determined to change soil pH into a range for yield response. Therefore, one original lime treatment received elemental S to reduce soil pH, another left as is and the last to further increase soil pH through additional liming. Treatments applied prior to tillage and planting.

Table 3. Influence of soil pH amendment, tillage system and corn on soil pH near Aurora SD in 2008. (28108)

| Treatment ^A | Conventional tillage (soil depth, inches) | | | | No-Till (soil depth, inches) | | | |
|------------------------|---|-------|-------|-------|-------------------------------------|-------|--------|------|
| | 0-2 | 2-4 | 4-6 | 6-12 | 0-2 | 2-4 | 4-6 | 6-12 |
| | ----- (-log[H ⁺]) ----- | | | | ----- (-log[H ⁺]) ----- | | | |
| check | 5.3 b | 5.4 b | 5.3 c | 5.6 b | 5.8 c | 5.4 c | 5.5 c | 5.8 |
| Elem. S ^B | 7.0 a | 7.5 a | 6.6 b | 5.7 b | 6.5 b | 7.0 b | 6.1 b | 5.6 |
| no lime | 7.6 a | 7.7 a | 7.3 a | 6.1 a | 7.6 a | 7.1 b | 6.4 ab | 5.9 |
| lime ^C | 7.6 a | 7.2 a | 6.6 b | 6.0 a | 7.6 a | 7.6 a | 6.8 a | 6.0 |
| LSD _(.10) | 0.8 | 0.8 | 0.6 | 0.2 | 0.5 | 0.4 | 0.5 | NS |
| Pr>F | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.31 |

^A 1998 to 2006 treatment plots were managed for increased pH over the check. Since the project ended in 2006 new objectives were determined to change soil pH into a range for yield response, therefore one original lime treatment received elemental S to reduce soil pH, another left as is and the last to further increase soil pH through additional liming.

^A Treatments applied prior to tillage and planting.

^B 2.5 tons elemental S / a

^C 4 tons Super Cal Lime / a

Table 4. Influence of soil pH amendment, tillage system and soybeans on soil pH near Aurora SD in 2008. (28208)

| Treatment ^A | Conventional tillage (soil depth, inches) | | | | No-Till (soil depth, inches) | | | |
|------------------------|---|-----|-----|------|-------------------------------------|-----|-----|------|
| | 0-2 | 2-4 | 4-6 | 6-12 | 0-2 | 2-4 | 4-6 | 6-12 |
| | ----- (-log[H ⁺]) ----- | | | | ----- (-log[H ⁺]) ----- | | | |
| check | Samples not yet taken. | | | | | | | |
| Elem. S ^B | | | | | | | | |
| no lime | | | | | | | | |
| lime ^C | | | | | | | | |
| LSD _(.10) | | | | | | | | |
| Pr>F | | | | | | | | |

^A 1998 to 2006 treatment plots were managed for increased pH over the check. Since the project ended in 2006 new objectives were determined to change soil pH into a range for yield response, therefore one original lime treatment received elemental S to reduce soil pH, another left as is and the last to further increase soil pH through additional liming.

^A Treatments applied prior to tillage and planting.

^B 2.5 tons elemental S / a

^C 4 tons Super Cal Lime / a