

# SOIL/WATER RESEARCH

## *South Dakota State University*

### 2008 Progress Report

Agricultural Experiment Station  
Plant Science Department  
South Dakota State University, Brookings, SD 57007

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#### **Corn yield response to N rate and lime application at the SE Research Farm in 2008. (1308)**

**A. Bly, R. Gelderman, and B. Berg**

#### **Introduction**

Low (acidic) soil pH can reduce crop productivity. Many South Dakota soils were derived from glacial activity and have calcium carbonate which makes the soil pH higher (basic). The application of nitrogen fertilizers over many years causes hydrogen ions to be present in the soil which promotes the formation of acids that reacts with the

calcium carbonate and therefore causes the pH to decrease. An N rate research study was started in the late 1980's at the SE Research Farm near Beresford. Very high rates (200 and 400 lbs N/a) were applied for corn in a corn/soybean rotation. The high rates of N have caused the soil in these plots to have much lower pH than treatments with lower N rates that are more close to crop removal. Therefore, a new study was imposed on the previous N rate study to determine the influence of lime application on soil pH, N mineralization from soil organic matter and corn grain yield.

#### **Materials and Methods**

| Item:                | Description:   |
|----------------------|--|
| location             | SE Research Farm near Beresford  |
| crop rotation        | corn / soybeans  |
| corn hybrid          | DKC 58-16 VT3 RR   |
| planting date / rate | April 23, (27,600 seeds/a)   |
| soil type            | Egan silty clay loam   |
| Soil N rates as urea | 0, 50, 100, 200, 400 lbs/a surface broadcast incorporate   |
| tillage              | disk, field cultivate  |
| lime application     | 4 tons/a Super-Cal 98G surface broadcast incorporate   |
| soil samples         | pre-treatment application from 0-6 and 6-24 inch<br>post-harvest from 0-6, 6-12, 12-24, and 24-36 inch |
| soil sample analysis | pH and NO <sub>3</sub> -N  |
| grain harvest date   | Oct. 10  |
| statistics           | RCBD split plot ANOVA  |

The previous N treatment plots (1992-2006) were split into with and without lime application. The lime and urea were incorporated.

## Results and Discussion

The pre-treatment soil analysis for each treatment showed the effect of previous N application rate. Soil nitrate (0-24") was elevated by the 200 and 400 lb/a N rates despite soybeans as a previous crop without any N applied (Table 1). Soil pH (0-6") decreased as N rate increased above 200 lbs N/a. Soil pH was significantly increased by lime application especially at the 200 and 400 lbs/a N rates (Table 2). Grain yield was significantly influenced by N rate

but not lime application (Table 3). The optimal N rate appears to be between 50 and 100 lbs N/a.

After harvest soil nitrate (0-3') was significantly higher as N rate increased (Table 4). Lime application did not significantly influence after harvest soil nitrate levels (0-3'). It is possible that not all of the applied lime (calcium carbonate) has reacted with the soil; therefore this study will be continued throughout the next few years.

Table 1. Pre-treatment<sup>1</sup> application soil test analysis for the lime and N rate study at the SE Research Farm in 2008.

| Previous <sup>2</sup><br>Treatment | 2008 <sup>3</sup><br>N rate | NO <sub>3</sub> -N<br>0-24" | Olsen P<br>----- | Ext. K<br>0-6" | salts<br>----- | pH  |
|------------------------------------|-----------------------------|-----------------------------|------------------|----------------|----------------|-----|
|                                    | ----- lbs/a -----           |                             | ----- ppm -----  |                |                |     |
| check-no nitrogen                  | 0                           | 42                          | 25               | 211            | 0.3            | 6.3 |
| Spring -Rec. N                     | 50                          | 42                          | 17               | 201            | 0.2            | 6.0 |
| Split - Rec. N                     | 100                         | 42                          | 20               | 191            | 0.2            | 5.7 |
| Fall - Rec. N                      | 150                         | 42                          | 17               | 180            | 0.2            | 6.0 |
| Spring 200                         | 200                         | 60                          | 22               | 208            | 0.2            | 5.5 |
| Spring 400                         | 400                         | 86                          | 24               | 197            | 0.3            | 5.0 |

<sup>1</sup> April 17, 2008

<sup>2</sup> N application timing and N rate (lbs/a), Rec N = Recommended N for corn (corn/soybean rotation) determined from yield goal and 0-24 inch soil test. (N rates applied to corn since 1988)

<sup>3</sup> Broadcast applied as urea and incorporated.

Table 2. Influence of N rate and lime application on post-harvest<sup>1</sup> soil pH (0-6 inch) at SE Research Farm near Beresford SD in 2008.

| N Rate <sup>1</sup><br>lbs/a | Lime Applied <sup>2</sup> |       | Pr>F |
|------------------------------|---------------------------|-------|------|
|                              | No                        | Yes   |      |
| 0                            | 6.6 a                     | 7.0 a | 0.04 |
| 50                           | 6.4 a                     | 6.7 b | 0.15 |
| 100                          | 6.4 a                     | 6.7 b | 0.24 |
| 150                          | 6.3 ab                    | 6.6 b | 0.09 |
| 200                          | 5.9 b                     | 6.4 c | 0.04 |
| 400                          | 5.2 c                     | 6.0 d | 0.05 |
| Pr>F                         | 0.001                     | 0.001 |      |
| LSD (.10)                    | 0.4                       | 0.2   |      |

<sup>1</sup> Nov, 2008

<sup>2</sup> pre-plant surface broadcast incorporated urea.

<sup>3</sup> 4 tons/a Super Cal 98G pre-plant surface broadcast incorporated urea.

Means with similar letter within a comparison column are not significantly different. (N rate x lime application Pr>F = 0.08)

Table 3. Influence of N rate and lime application on corn grain yield at SE Research Farm near Beresford SD in 2008.

| N Rate <sup>1</sup><br>lbs/a | Lime Applied <sup>2</sup> |         | mean yield | Pr>F |
|------------------------------|---------------------------|---------|------------|------|
|                              | No                        | Yes     |            |      |
| 0                            | 98.6 d                    | 103.1 c | 100.9 c    | 0.52 |
| 50                           | 134.5 c                   | 136.5 b | 135.5 b    | 0.71 |
| 100                          | 149.1 b                   | 149.7 a | 149.4 a    | 0.95 |
| 150                          | 152.3 ab                  | 151.8 a | 152.0 a    | 0.89 |
| 200                          | 156.2 a                   | 153.6 a | 154.9 a    | 0.50 |
| 400                          | 148.1 b                   | 151.8 a | 149.9 a    | 0.07 |
| Pr>F                         | 0.001                     | 0.001   | 0.001      |      |
| LSD (.10)                    | 6.8                       | 9.6     | 6.4        |      |

<sup>1</sup> pre-plant surface broadcast incorporated urea.

<sup>2</sup> 4 tons/a Super Cal 98G pre-plant surface broadcast incorporated urea.

<sup>3</sup> adjusted to 15% moisture

Means with similar letter within a comparison column are not significantly different. (N rate x lime application Pr>F = 0.93)

Table 4. Influence of N rate and lime application on post-harvest<sup>1</sup> soil nitrate (0-3 ft.) at SE Research Farm near Beresford SD in 2008.

| N Rate <sup>2</sup><br>lbs/a | Lime Applied <sup>3</sup> |        | mean  | Pr>F |
|------------------------------|---------------------------|--------|-------|------|
|                              | No                        | Yes    |       |      |
| 0                            | 57 c                      | 56 c   | 56 c  | 0.74 |
| 50                           | 86 c                      | 74 c   | 80 c  | 0.44 |
| 100                          | 76 c                      | 84 c   | 80 c  | 0.42 |
| 150                          | 93 c                      | 130 bc | 111 c | 0.08 |
| 200                          | 201 b                     | 191 b  | 196 b | 0.81 |
| 400                          | 490 a                     | 423 a  | 456 a | 0.62 |
| Pr>F                         | 0.001                     | 0.001  | 0.001 |      |
| LSD (.10)                    | 85                        | 76     | 63    |      |

<sup>1</sup> Nov. 2008

<sup>2</sup> pre-plant surface broadcast incorporated urea.

<sup>3</sup> 4 tons/a Super Cal 98G pre-plant surface broadcast incorporated urea.

Means with similar letter within a comparison column are not significantly different. (N rate x lime application Pr>F = 0.81)