

# Corn: Nitrogen Applications



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**Experiment:** Sidedress Nitrogen Comparisons in Corn  
**Year:** 2000 (00-14)  
**Date of Planting/Harvest:** April 27 / October 18  
**Plot Size:** 4 row x 178 ft. (3 replications)

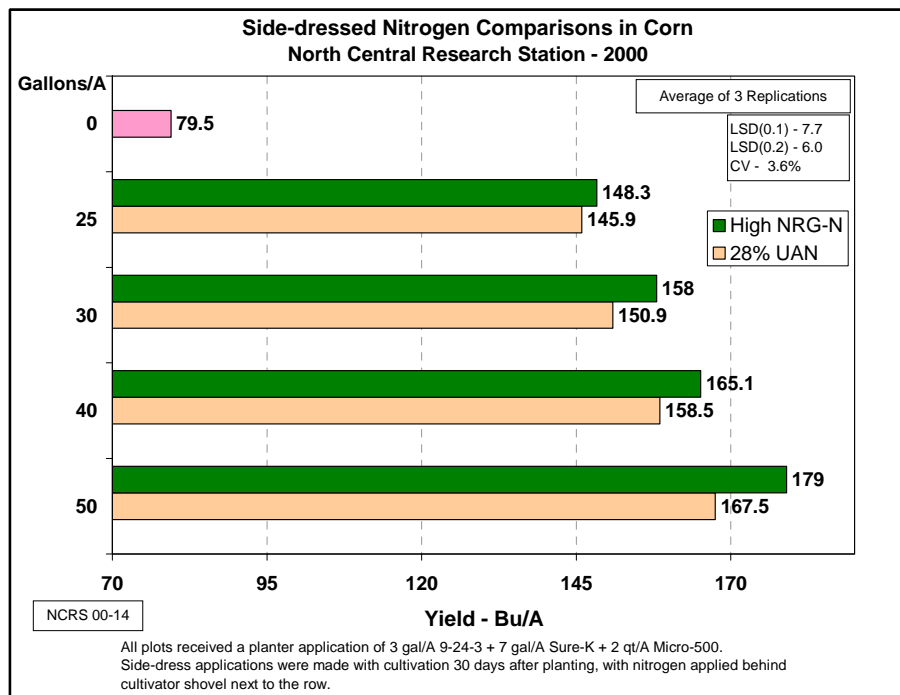
**Soil Test Levels**  
 pH: 6.7    CEC: 3.8  
 OM: 1.7%    P1:79 ppm  
 K: 66 ppm

High NRG-N is more than just a nitrogen fertilizer. It contains multi-form nitrogen, sulfur, micronutrients, and organic chelates that enable slow release of chelated ammonium nitrogen. This enables improved crop utilization efficiency. Research and field use by growers has shown equal yield performance between conventional nitrogen sources at normally recommended rates, and High NRG-N at rates that apply as much as 40% less nitrogen per acre.

Objective: This experiment was designed to compare equal volume rates of High NRG-N and 28% UAN applied at side-dress with cultivation 30 days after planting.

The entire experimental are received a planter application of 3 gal/A 9-24-3 + 7 gal/A Sure-K + 2 qt/A Micro 500. This ground is very sandy and prone to drought stress. Following cultivation and side-dress application, drip irrigation line was installed between each row, and approximately 1 inch of water was applied per week through the growing season. Treatment yields appear in Chart 1.

- Due to irrigation, there was increased yield with increased rate of nitrogen application. (In most



non-irrigated situations, the yield response curve flattens out well before this maximum application rate.)

- Within each rate of nitrogen application over 25 gal/A, High NRG-N produced significantly higher yields than the same rate of 28% UAN.
- Generally, the yield obtained with application of a particular rate of 28% UAN was equal to that obtained with a rate 10 gal/A less of High NRG-N.

**Experiment:** Nitrogen Comparisons in Corn  
**Year:** 2001 (01-24)  
**Date of Planting/Harvest:** May 2 / November 8  
**Plot Size:** 4 row x 240 ft.

**Soil Test Levels**

pH:6.5    CEC: 8.3 OM: 2.6%  
P1: 58 ppm  
K: 35 ppm (1.1 % base sat.)

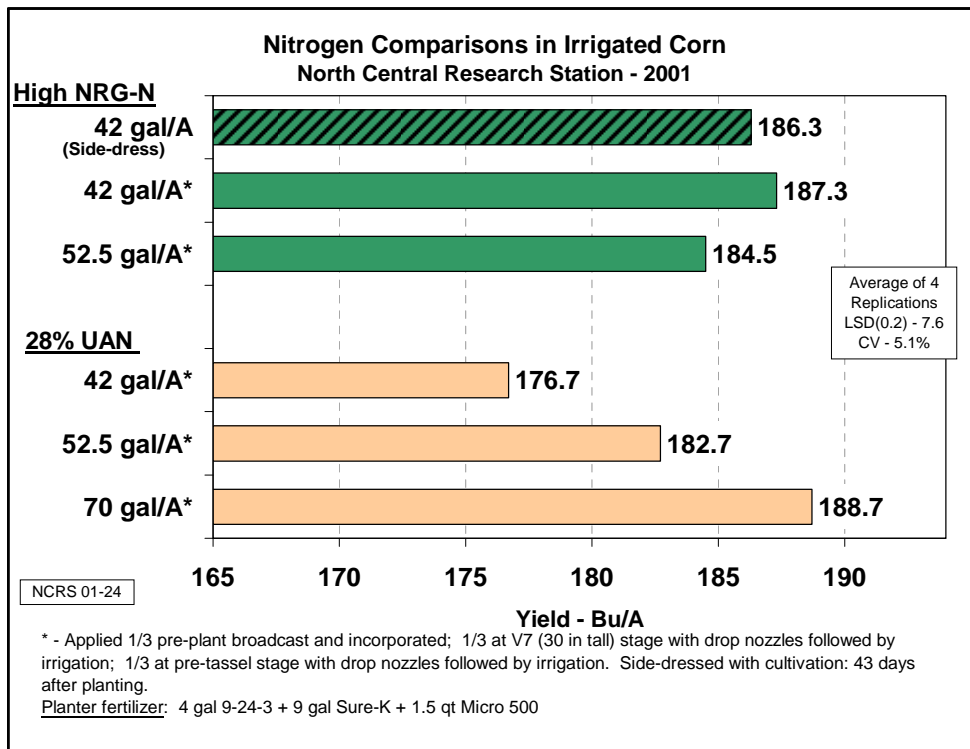
High NRG-N has the advantage of a lower application volume of up to 40% compared to conventional 28% UAN. This is due to the supplementation with sulfur and chlorophyll-building micronutrients, nitrogen stabilization, lower salt index, and other formulation differences.

Growers using High NRG-N on irrigated corn have had good success with split applications. One recommended method is to apply one-third of the total volume pre-plant incorporated (as with a herbicide), one-third at 24 to 30 inches tall (around V7 stage), and one-third at the pre-tassel stage. (The second and third application is through the irrigation pivot.) Of course, some growers let the application run longer than at these specific stages, and “spoon-feed” over a longer period. But it is important to have all of the nitrogen on by pre-tassel to make sure that the nitrogen will be released and absorbed during ear development. An experiment was conducted to evaluate nitrogen applications to irrigated corn.

Objectives:

1. Compare single side-dress application of High NRG-N to split application described above.
2. Compare different rates of High NRG-N and 28% UAN for effects on corn yield.

All plots received the same planter-application of 4 gal/A 9-24-3 + 9 gal/A Sure-K + 1.5 qt/A of Micro 500. The pre-plant spray applications were applied 2 days before planting on April 30. It is not possible to apply the different treatments of nitrogen solutions through overhead irrigation to 4-row randomly arranged plots. So to simulate this, applications were made with a high-boy sprayer with drop nozzles, followed by irrigation of the entire experiment. Average yield results appear in the following graph.



- The usual rate of 42 gal/A of **High NRG-N significantly out yielded** the same rate of **28% UAN**.
- Increasing the rate of High NRG-N to 52.5 gal/A did not further increase corn yield. This may indicate that the nitrogen requirement was met with 42 gal/A.

- Unlike High NRG-N, there was a rate response with 28% UAN as increasing rate brought increasing yield. This shows that **lowered rates of 28% UAN are not as effective as High NRG-N.**
- **High NRG-N** at the recommended rate of **42 gal/A** produced yield similar to that produced with **70 gal/A of 28% UAN**, although with **28 less gallons per acre.**

**Experiment:** Fertilizer program comparisons in irrigated corn  
**Year:** 2002 (02-29)  
**Date of Planting/Harvest:** May 5 / October 28  
**Plot Size:** 4 row x 210 ft.

**Soil Test Levels**

pH: 7.0      EC: 7.0  
OM: 1.5%    P1: 40  
ppm K: 146 ppm

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The importance of soil sampling and knowing the nutrient levels of soil is regularly stressed when determining fertilizer inputs for crops. Many agronomists advocate using the “spring nitrate” soil test as a guide for determining in-season nitrogen application rates for corn. The spring nitrate test measures the available nitrate in the soil just prior to in-season application, such as side-dress. Through the use of developed formulas, an application rate can be determined so as not to over or under fertilize with nitrogen.

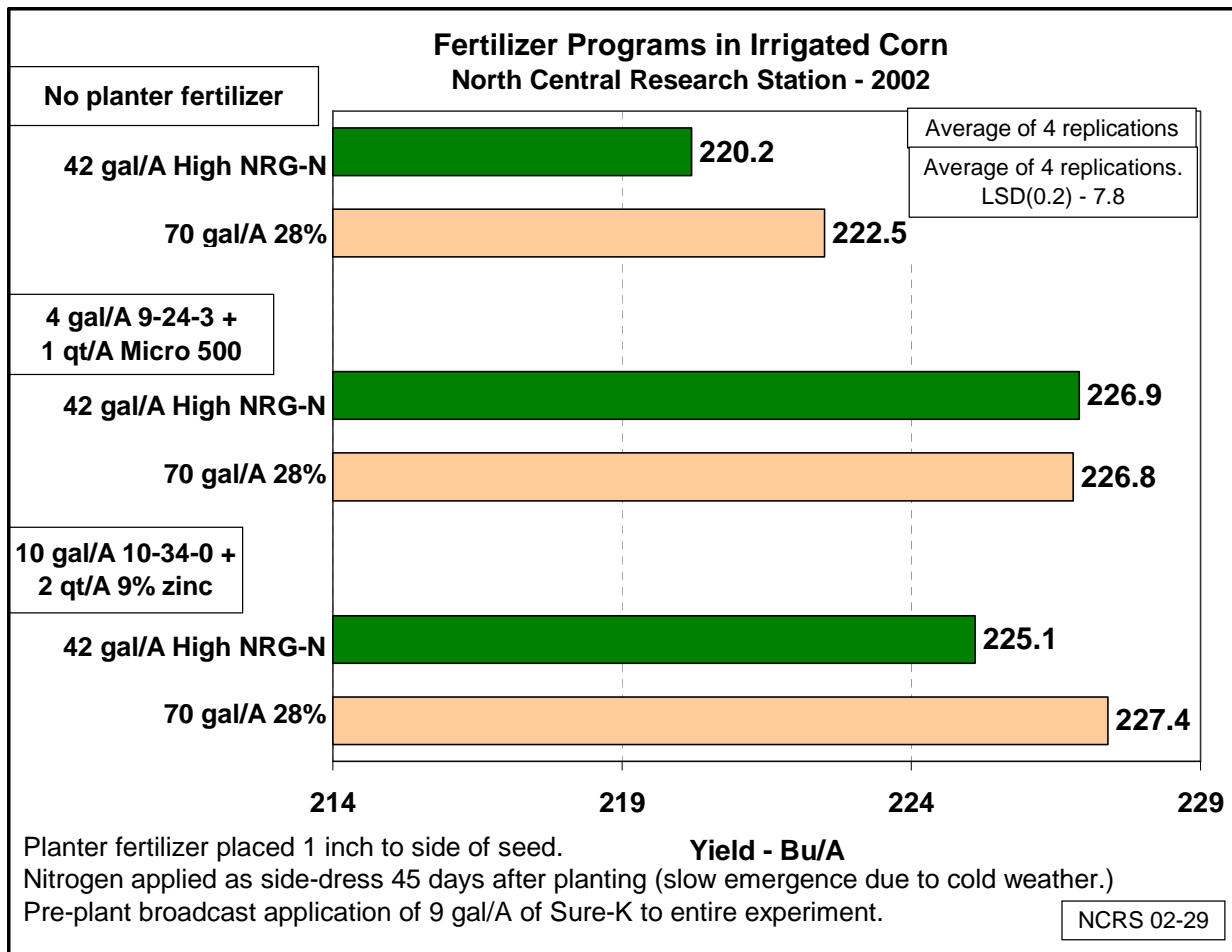
Objectives:

1. Compare liquid phosphate fertilizers Pro-Germinator 9-24-3 and 10-34-0, plus liquid nitrogen fertilizers High NRG-N and 28% UAN for effects on corn yield.
2. Compare “standard” nitrogen rate applications with those using the spring nitrate test as a rate guide for effects on corn yield.

The field used on Farm 3 is very sandy (avg. CEC of 6) and has not had corn planted in over 10 years due to moisture concerns. It had been planted to soybeans, wheat or edible beans. However, with the linear overhead irrigation on the farm, it is now well suited for corn. This experiment examines different phosphate and nitrogen fertilizer programs. A broadcast application of Sure-K at 9 gallons per acre was made prior to planting over the entire experiment. The experiment originally contained five replications, but raccoon damage in the fifth replication resulted in using only four replications for average yield determination, but all 5 replications were sampled for soil nitrate determination. An average final stand of 33,000 plants per acre was established with no significant variations due to treatment.

**1. Fertilizer program comparison.**

Soil phosphorus level in the experiment averaged 41 ppm. Based on a yield goal in the 200 Bu/A range, a planter fertilizer rate of 4 gal/A of 9-24-3 was determined and compared against a 10 gal/A rate of 10-34-0. (Incidentally, the *crop service* that did the grid sampling of this field recommended 230 lb/A of P<sub>2</sub>O<sub>5</sub>, or 500 lb/A of 0-46-0, for *production* of this yield plus build up of P level, which we felt was ridiculous.) For nitrogen on this sand, a 70 gal/A rate (210 lb-N) of 28% UAN was set as the standard, and compared to a 42 gal/A rate of High NRG-N (122 lb-N, or 58% of the conventional rate). These nitrogen rates were applied to corn which either had planter-applied 9-24-3 or 10-34-0, or no planter fertilizer. Yield results appear in the following chart.



- Application of planter-applied phosphate fertilizer resulted in increased average corn yield, although yield increase was not statistically significant. The 4 gal/A rate of 9-24-3 was similar in yield to the 10 gal/A rate of 10-34-0.
- Both the 42 gal/A rate of High NRG-N and the 70 gal/A rate of 28% UAN produced similar corn yields over 225 Bu/A, which is in excess of the yield goal of 200 Bu/A.

## 2. Using soil nitrate test as a guide for in-season nitrogen applications.

Soil samples were collected for nitrate analysis 37 days after planting, when the corn was in the 3 to 4 leaf stage. This is smaller than normal at this time period due to slow emergence from unusually cold conditions following planting. There were three planter-applied fertilizer programs under evaluation:

1. No planter fertilizer
2. Planter-applied phosphate fertilizer: 4 gal/A 9-24-3 and 10 gal/A 10-34-0.
3. Planter-applied phosphate and nitrogen fertilizer: 4 gal/A 9-24-3 + 15 gal/A High NRG-N and 10 gal/A 10-34-0 + 15 gal/A 28% UAN.

The phosphate fertilizers (#2 above) were applied 1 inch to the side of the seed, and the phosphate and nitrogen fertilizers were applied in 2x2 placement. With these band

applications, soil sampling for nitrate levels presents a challenge. Sampling was conducted using the “sets of eight” pattern as described Iowa State University extension bulletin Pm-1714. Using this method, the first core is collected in a row, the second one-eighth of the distance between two rows, the third one-quarter of the distance, and so on until the eighth sample is collected seven-eighths of the distance between any two rows. Move on randomly through the area between samples. This was done twice per plot for a total of 16 cores from a depth of 1 foot each. All five replications were sampled separately. Samples were submitted to a lab (Midwest Labs, Omaha, NE) for nitrate analysis.

Different states have their own formulas for nitrogen rate determination based on soil nitrate results. The formula developed by Michigan State University was used here. In determining the regular and nitrate guide rates of High NRG-N, the increased efficiency assumption was used where 1 gallon of High has the performance equivalent of 5 pounds of nitrogen. Soil nitrate treatment results and interpretations appear in the following table.

| Table 1. Spring soil nitrate levels 37 days after planting.<br>North Central Research Station - 2002 |              |                   |                    |      |
|--|--------------|-------------------|--------------------|------|
| Planter fertilizer*  | Soil nitrate | Nitrate guide**** | gal/A              |      |
|  | ppm          | lb-N/A            | 28% UAN High NRG-N |      |
| 1. No planter fertilizer   | 22           | 68                | 23                 | 14   |
| 2. 4 gal/A 9-24-3**  | 24.6         | 52.4              | --                 | 10.5 |
| 3. 10 gal/A 10-34-0***   | 38.8         | 0                 | 0                  | --   |
| 4. 4 gal/A 9-24-3 +<br>15 gal/A High NRG-N**   | 45.2         | 0                 | --                 | 0    |
| 5. 10 gal/A 10-34-0 +<br>15 gal/A 28% UAN***   | 65.2         | 0                 | 0                  | --   |

Data average of 5 replications. Sixteen 12 inch cores per replication.  
 \*- Placement: #2,3: 1 inch to side of seed; #4,5: 2x2 from seed.  
 \*\*- + 1 qt/A Micro 500  
 \*\*\*- + 2 qt/A 9% zinc  
 \*\*\*\*- Using soil nitrate as a guide for side-dress application rate:  
 using Michigan State University formula:  $\frac{\text{standard N rate} - (\text{ppm nitrate} \times 6)}{5}$   
 and using a standard N rate of 200 lb/A for 200 bushel yield goal.

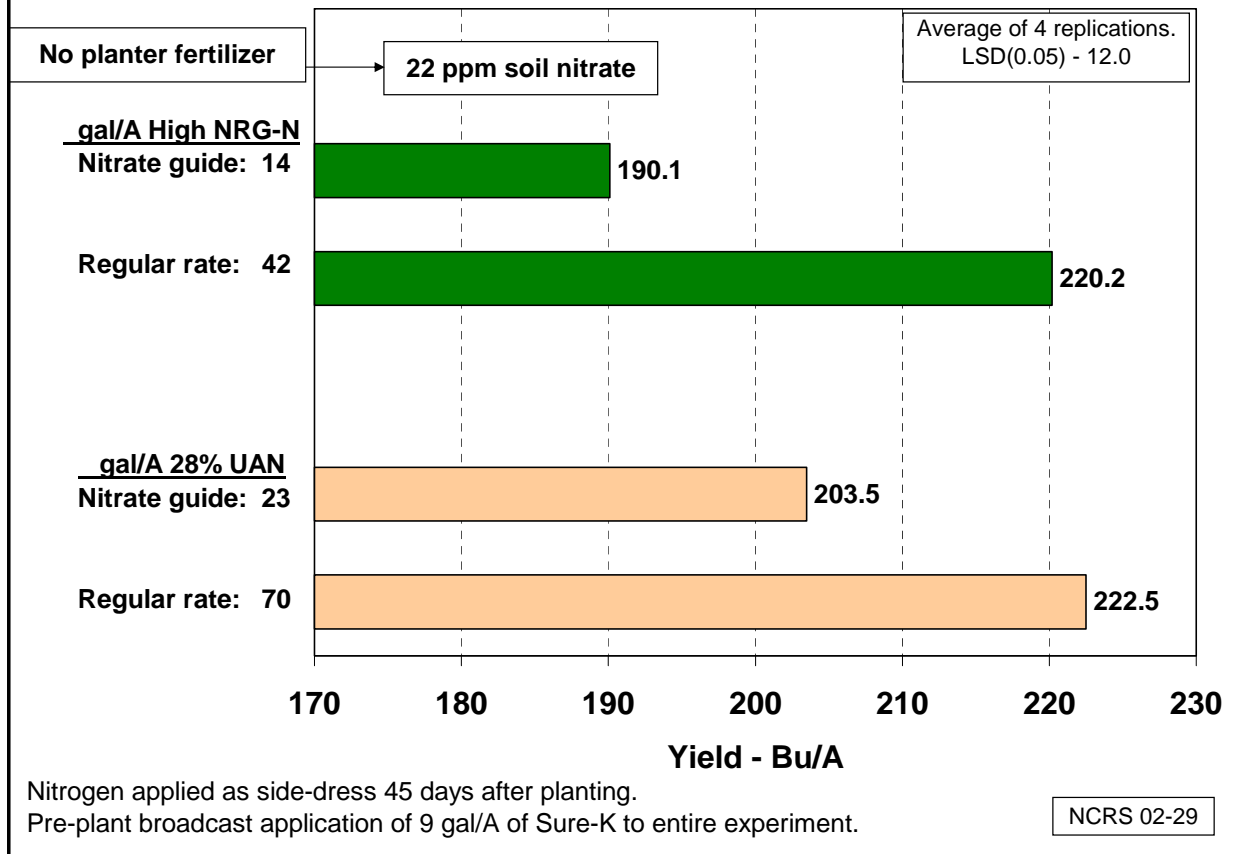
- Nitrate levels within treatments were very consistent across replications.
- Nitrate levels were all in the high range, even the no fertilizer treatment. Thus, based on this, nitrogen application rates were low. The treatment with 10-34-0, and the ones with 15 gal/A of nitrogen at planting called for no additional nitrogen.
- The higher soil-nitrate level with equal rate of 28% compared to High NRG-N (Trt. 4 and 5) may be explained by chelation and stabilization of nitrate nitrogen in High NRG-N.

As a comparison to the nitrate-based recommendation, the standard rates of nitrogen (42 gal/A High NRG-N and 70 gal/A 28% UAN) were also applied. Yield data will determine the validity of the nitrate-based nitrogen recommendations.

### No planter fertilizer.

When no planter fertilizer was applied, the nitrate-guide rates and the standard rates of applied nitrogen produced yields shown in Chart 2.

**Chart 2. Using soil nitrate-test as a guide for side-dress N application.**  
**North Central Research Station - 2002**

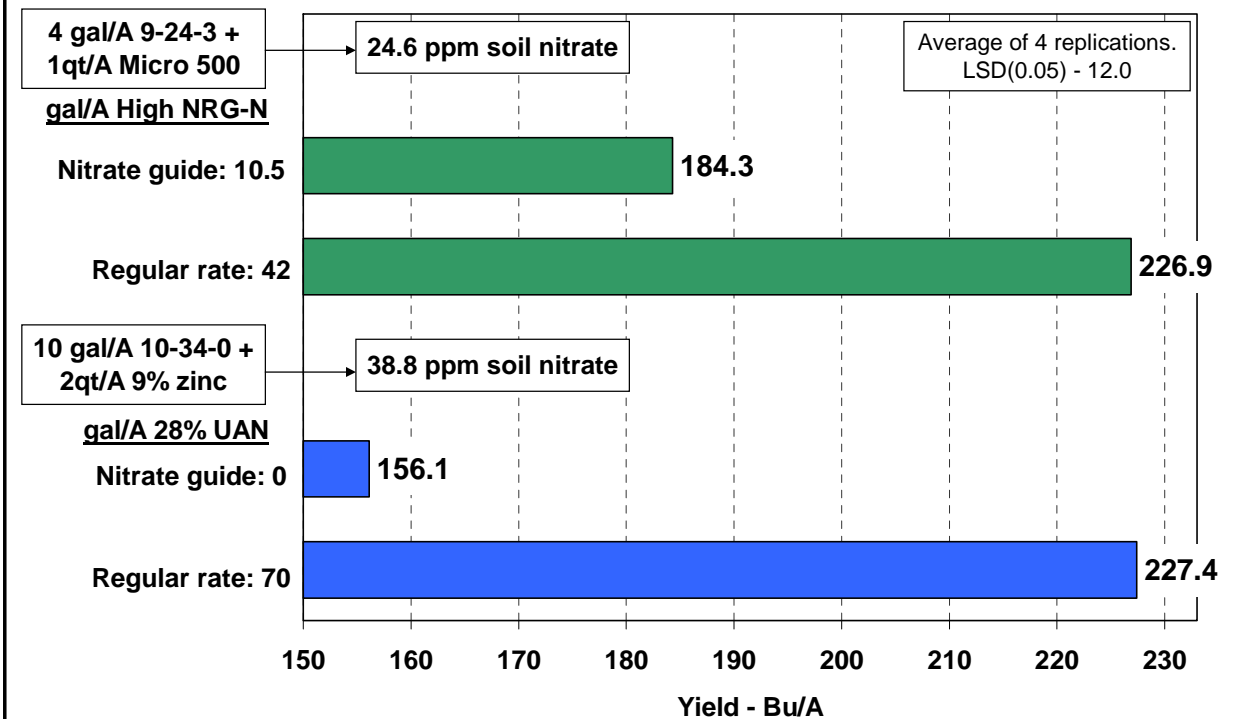


- The corn, which received the nitrate-guide rates, yielded significantly less than the regular rates.
- With the regular application, there was no difference in the yield between the two nitrogen fertilizers. But at the lower rates based on nitrate level, the 23 gal/A of 28% yielded more than the 14 gal/A rate of High NRG-N.

**Planter-applied phosphate fertilizer.**

When 4 gal/A of 9-24-3 was applied by the planter, the nitrate guide formula determined that additional nitrogen is needed. It was determined that 10.5 gal/A of High NRG-N would meet this requirement. But nitrate level was sufficiently high following 10 gal/A 10-34-0 that no additional nitrogen was recommended according to the formula. Corn yields under this program are in Chart 3.

**Using soil-nitrate test as a guide for side-dress applications  
North Central Research Station - 2002**



Planter fertilizer placed 1 inch to side of seed.  
 Nitrogen applied as side-dress 45 days after planting. See text for nitrate guide rates.  
 Pre-plant broadcast application of 9 gal/A of Sure-K to entire experiment.

NCRS 02-29

- The regular nitrogen applications in each case significantly out-yielded the nitrate guide rates by a large margin.
- The 10-34-0 treatment, where no nitrogen was recommended by the formula, was visibly chlorotic later in the season.

In conclusion, the nitrate guide was not effective in this experiment. It may be that the nitrate that was present at the time of sampling was leached by irrigation in this sandy soil. Late season deep soil nitrate testing may have explained this if such sampling had been conducted. It also is not clear why the nitrate levels were so high to begin with. These levels were quite high to be from residual bean nodulation.

It may be that the regular rates are too high for these high-nitrate conditions, but it was obvious that the nitrate guide rates were too low. This experiment may be repeated in 2003.

**Experiment:** Using Soil Nitrate Level for Sidedress Nitrogen Application Rate In Corn

**Year:** 2003 (03-16)

**Date of Planting/Harvest:** April 29 / November 7

**Plot Size:** 4 row x 210 ft. (5 replications)

**Soil Test Levels**

pH: 6.8 CEC : 5.0  
OM: 1.4% P1: 38 ppm  
K: 62 ppm

Soil sampling is widely advocated as a means to accurately determine fertilizer application needs. Based on more recent studies, nitrogen application rates can be determined by soil sampling to a depth of one foot prior to side-dress and analyzing for soil nitrates. Nitrate levels can be used to determine optimum nitrogen application rate so as not to over or under apply. Different states have formulas to use for optimum rate determination based on this spring nitrate test.

In an experiment conducted at the NCRS in 2002, it was found that the spring nitrate test was not effective for optimum production, as calculated rates of both 28% UAN and High NRG-N were too and resulting yields were significantly lower than those where standard application rates of nitrogen were used. This experiment was reported in the 2002 Research Report. Another experiment was conducted in 2003 to further evaluate the spring nitrate test rate determination compared to standard rates of nitrogen application.

Based on a corn yield goal in excess of 200 Bu/A, a standard nitrogen application rate of 210 lb-N/A is used. This would be equal to 70 gal/A of 28% UAN or 42 gal/A of High NRG-N. (Due to manufacturing processes, that make High NRG-N more efficient than conventional formulations of nitrogen fertilizers, an equivalent calculation of 5 lb of nitrogen per gallon is used even though there is 2.9 lb of actual nitrogen per gallon. So for 210 lb-N/A, 42 gal/A of High NRG-N is applied.)

In this experiment, no planter-applied fertilizers were used in order to remove possible influence on soil nitrate levels. However, a pre-plant broadcast application of 9 gal/A of Sure-K was made to the entire experiment to avoid possible potassium deficiencies.

Soil nitrate samples were collected 40 days after planting by taking 16-1 ft cores per plot. Samples were collected by starting in a row, and moving one-eighth of the distance to the next row between samples, as you moved down the length of the plot, until 16 samples were collected. Samples were sent to Midwest Laboratories for nitrate analysis. Results were consistent and similar across plots. For rate determination, the Michigan State University formula was used:

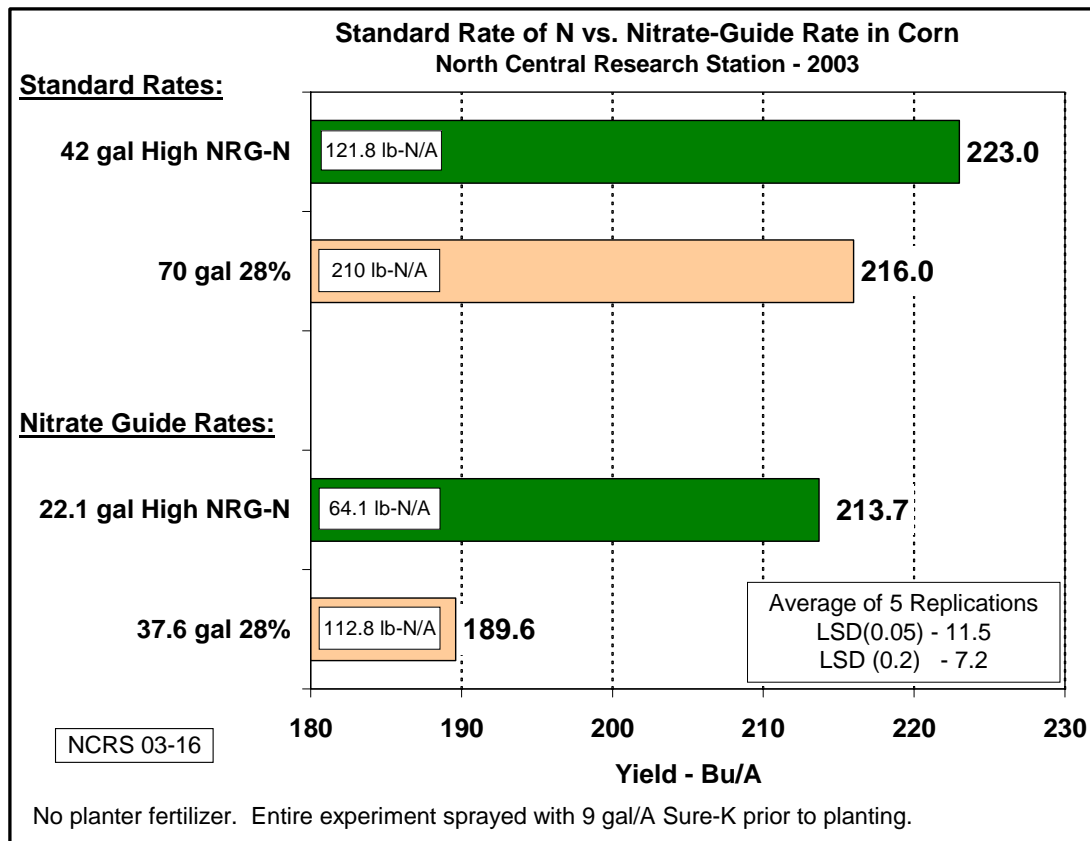
**Standard N rate in lb/A - (ppm nitrate x 6) = lb-N/A to apply**

For a standard N rate of 210 lb/A and average nitrate levels found, calculated nitrogen rates for 28% UAN and High NRG-N appear in the following table, based on sampling prior to application.

| Table 1. Soil nitrate levels and nitrogen rate determination<br><i>North Central Research Station - 2003</i> |                            |                      |              |
|--|----------------------------|----------------------|--------------|
|  | <u>avg. nitrate level*</u> | <u>lb-N to apply</u> | <u>gal/A</u> |
| 28% UAN:   | 16.2 ppm                   | 112.8                | 37.6         |
| High NRG-N:  | 16.6 ppm                   | 110.5                | 22.1**       |

\* - average of 16 samples per plot over 4 replications.  
 \*\* - for High NRG-N, use "equivalent" rate of 5 lb-N per gallon

These rates determined by the nitrate test were compared to the standard rates of 70 gal/A for 28% UAN and 42 gal/A for High NRG-N. Sidedress applications were made 50 days after planting when the corn was at the V5 stage and 13 inches tall. (This application was later than normal due to slow early corn growth due to weather conditions.) Resulting yields are in the following chart.



- The standard nitrogen application rates resulted in higher corn yield than the nitrate guide rates.
- High NRG-N produced higher corn yield than did 28% in each case even though substantially fewer gallons per acre (and lb-N per acre) were applied.
- High NRG-N can save time in being able to cover more acres between fill-ups, requires less storage space, and is more environmentally sound by doing a better job with fewer pounds of nitrogen applied.

Fertilizer program comparison in corn. Ag Advisory, Ltd., Algon, Iowa.

This experiment is very similar to an experiment conducted at the North Central Research Station reported earlier in this document (NCRS 02-29). The objectives here were the same:

Objectives:

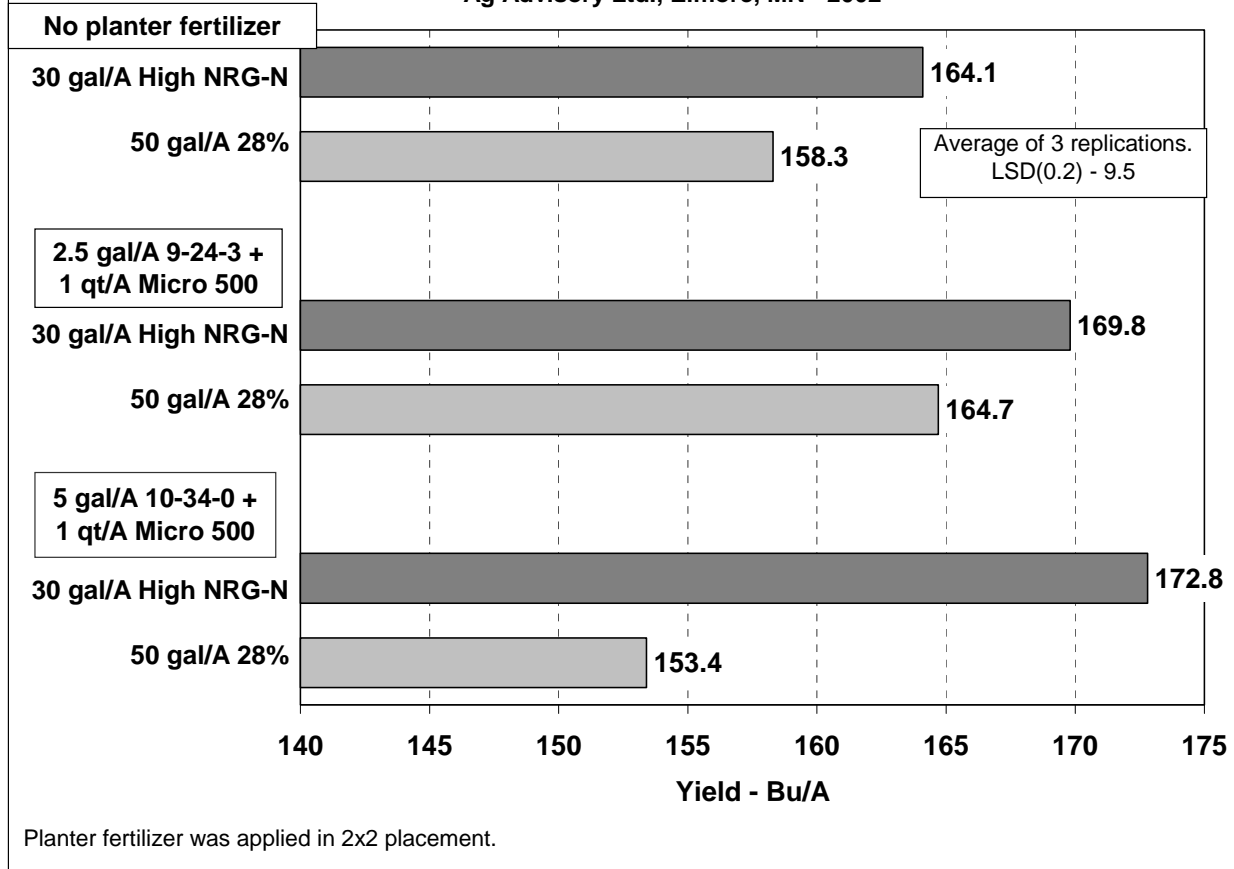
1. Compare liquid phosphate fertilizers Pro-Germinator 9-24-3 and 10-34-0, plus liquid nitrogen fertilizers High NRG-N and 28% UAN for effects on corn yield.
2. Compare "regular" nitrogen rate applications with those using the spring soil nitrate test as a rate guide for effects on corn yield.

The experiment was conducted near Elmore, MN which is in South Central Minnesota near the Iowa border. "Plot" size was 12-30 inch rows wide by a half mile long. Treatments were replicated 3 times. Yields were collected using combine yield monitor. The field was planted to corn the previous year. Soil test data averaged 7.4 pH, 5.9% organic matter, 44 ppm phosphorus (P1), and 159 ppm potassium.

### **1. Fertilizer program comparison.**

Based on the soil phosphorus level, a base planter-applied fertilizer rate of 5 gal/A of 10-34-0 was used. Pro-Germinator 9-24-3 at 2.5 gal/A was used in comparison. To be equal, 1 qt/A of Micro 500 was added to both. For nitrogen, a base rate of 50 gal/A of 28% UAN was used as a side-dress application. For comparison, 30 gal/A of High NRG-N was used. This is consistent with the use rate of High NRG-N to be 60% of that of "conventional" nitrogen fertilizers due to nutritional enhancement. Each of these nitrogen treatments was applied to corn which received a planter fertilizer application either 10-34-0, Pro-Germinator 9-24-3, or no planter fertilizer. Yield results appear in the following chart.

Chart 1. Planter Fertilizer and Side-dress Nitrogen Comparisons in Corn  
Ag Advisory Ltd., Elmore, MN - 2002



- Although greater numerically, there was not a significant yield response to the planter-applied phosphate fertilizers. Averaged over nitrogen treatments, the 9-24-3 out-yielded the 10-34-0 167.3 to 163.1 Bu/A, compared to 161.2 for no planter fertilizer.
- In each comparison, the lower rate of High NRG-N out-yielded the higher rate of 28% UAN. The conventional application was 150 lb-N/A vs. 85.8 lb-N/A with High NRG-N. (The low yield with 28% and 10-34-0 of 153.4 was not due to an unusually low yield in one of the replications.)

### Using soil nitrate test as a guide for in-season nitrogen applications.

Soil samples were collected and analyzed for nitrate prior to side-dressing. Nitrate levels were quite low due to the fact that this is second year corn. The nitrate levels were used as a guide for determining side-dress N rates. For comparison, these rates were compared to “regular” rates of N application. These “regular” rates were the same 50 gal/A of 28% UAN and 30 gal/A of High NRG-N discussed earlier.

There were three planter-applied fertilizer programs under evaluation:

1. No planter fertilizer.
2. Planter-applied phosphate fertilizer:
  - 2.5 gal/A Pro-Germinator 9-24-3 + 1 qt/A Micro 500
  - 5 gal/A 10-34-0 + 1 qt/A Micro 500.
3. Planter-applied phosphate and nitrogen fertilizer:

- 2.5 gal/A 9-24-3 + 15 gal/A High NRG-N + 1 qt/A Micro 500
- 5 gal/A 10-34-0 + 15 gal/A 28% UAN + 1 qt/A Micro 500

Planter fertilizers were applied in 2x2 placement. Soil samples were collected using the same “sets of eight” described in the similar NCRS experiment, which comes from Iowa State University extension bulletin Pm-1714. Soil nitrate analysis was conducted by Belmond Labs of Belmond, IA. Soil nitrate treatment results and interpretations appear in the following table.

| Planter fertilizer*                            | Soil nitrate<br>ppm | Nitrate guide***<br>lb-N/A | gal/A**** |            |
|--|---------------------|----------------------------|-----------|------------|
|  |                     |                            | 28% UAN   | High NRG-N |
| 1. No planter fertilizer                       | 5                   | 160                        | 53        | 32         |
| 2. 2.5 gal/A 9-24-3**                          | 7.4                 | 141                        | 47        | 28         |
| 3. 5 gal/A 10-34-0**                           | 7.4                 | 141                        | 47        | 28         |
| 4. 2.5 gal/A 9-24-3 +<br>15 gal/A High NRG-N** | 11                  | 111                        | --        | 22         |
| 5. 5 gal/A 10-34-0 +<br>15 gal/A 28% UAN**     | 11                  | 111                        | 37        | --         |

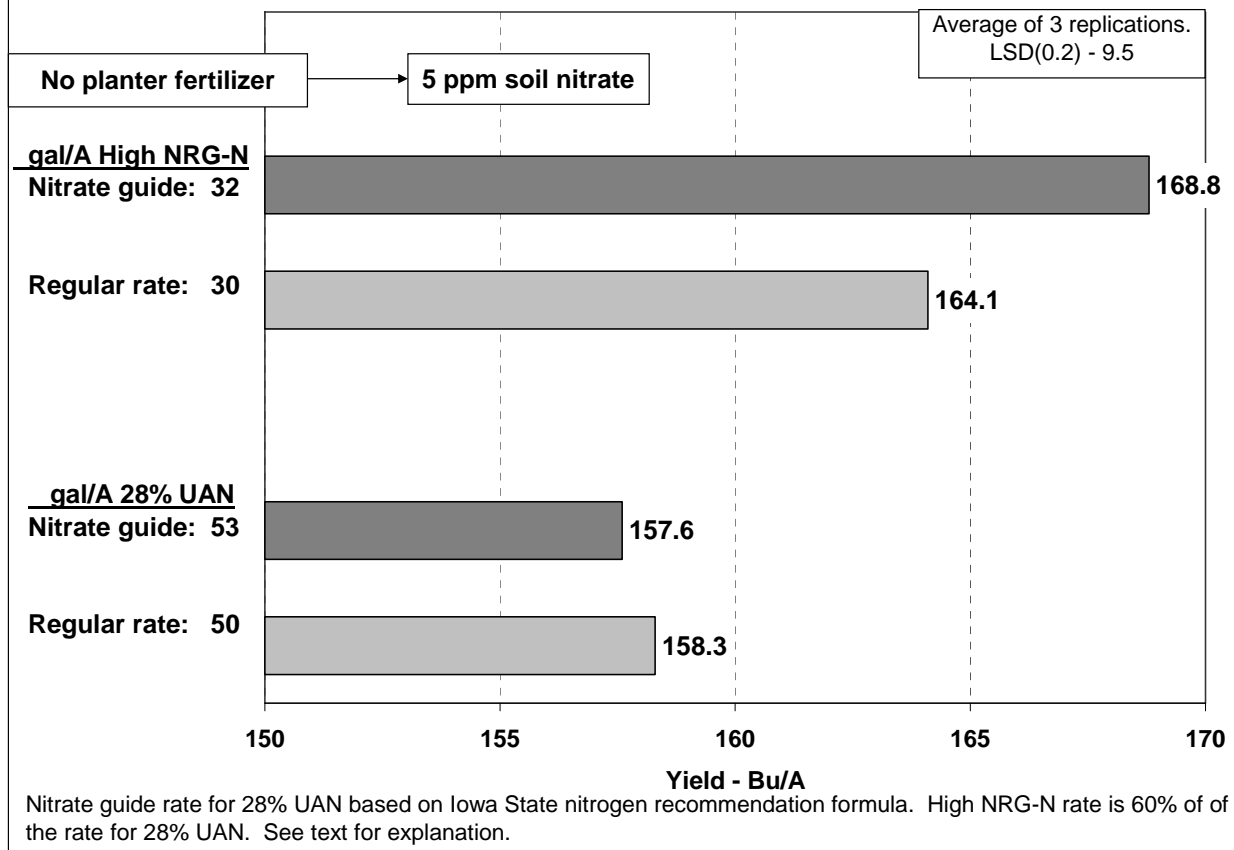
Data average of 3 replications.  
 \*- Placement: #2,3: 1 inch to side of seed; #4,5: 2x2 from seed.  
 \*\*- + 1 qt/A Micro 500  
 \*\*\*- Using soil nitrate as a guide for side-dress application rate:  
 using Iowa State University formula: (25 - ppm nitrate) x 8 = lb of N to apply.  
 \*\*\*\*- gal/A of 28% UAN based on nitrate guide, and High NRG-N rate is 60% of the conventional 28% UAN rate.

- Nitrate levels are low indicating need for applied nitrogen.
- Note: the fact that identical nitrate values were found in trt. 2 and 3, and in trt. 4 and 5 is coincidental.

**No planter fertilizer.**

When no planter fertilizer was applied, the nitrate-guide rates and the standard rates of applied nitrogen produced yields shown in Chart 2.

**Chart 2. Using soil-nitrate test as a guide for side-dress N application  
Ag Advisory Ltd., Elmore, MN - 2002**

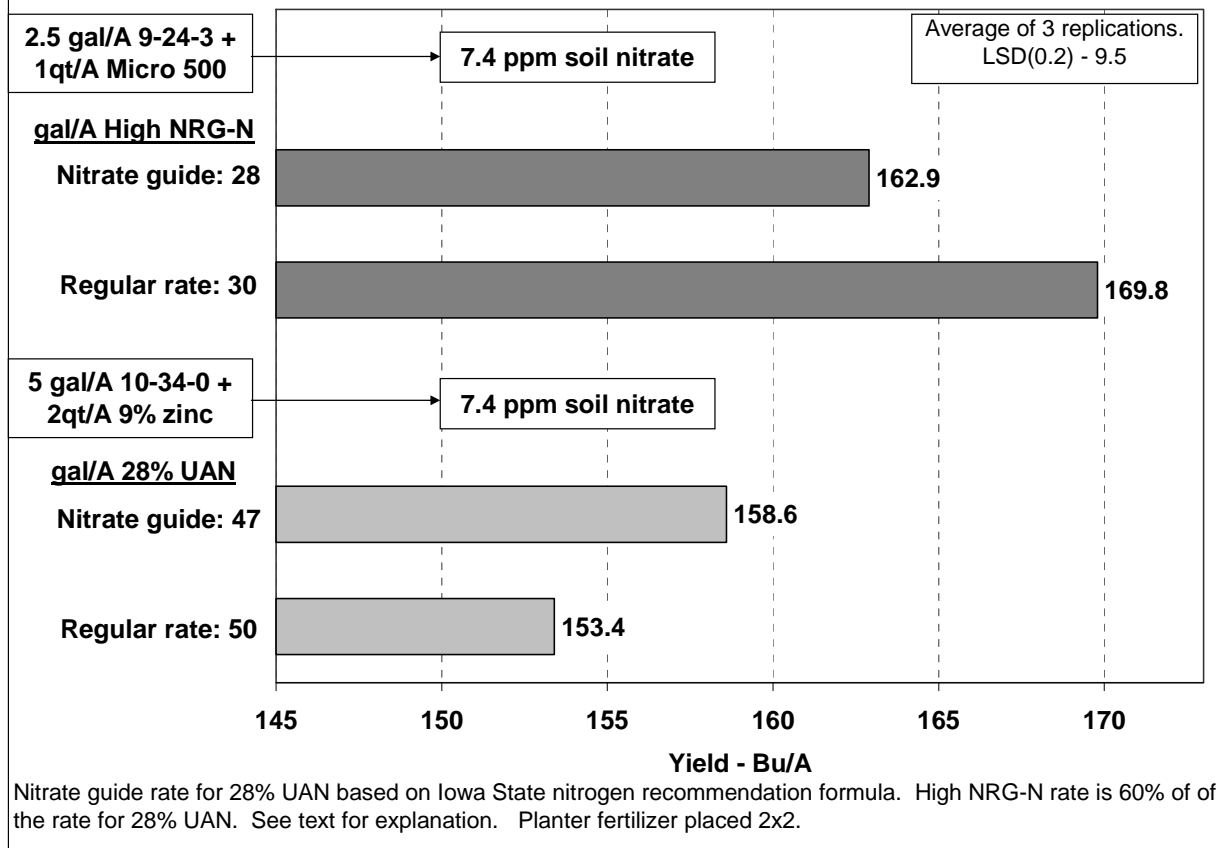


- The nitrogen-guide rates were very close to the “regular” rates, and there was no significant difference between yields of the rates applied within the two nitrogen types.
- The yield produced with 32 gal/A of High NRG-N was significantly higher than either rate of 28% UAN, even though those rates were 18 to 21 gallons per acre higher.

**Planter-applied phosphate fertilizer.**

Application of the two phosphate fertilizers did slightly increase soil nitrate levels due to the nitrogen components. But levels were still low and indicated a need for additional applied nitrogen. As when no planter-applied fertilizer was used, the nitrate-guide formula rates were again close to the “regular” rates, although slightly lower. Treatment yields appear in the following chart.

**Chart 3. Using soil-nitrate test as a guide for side-dress N applications  
Ag Advisory Ltd., Elmore, MN - 2002**

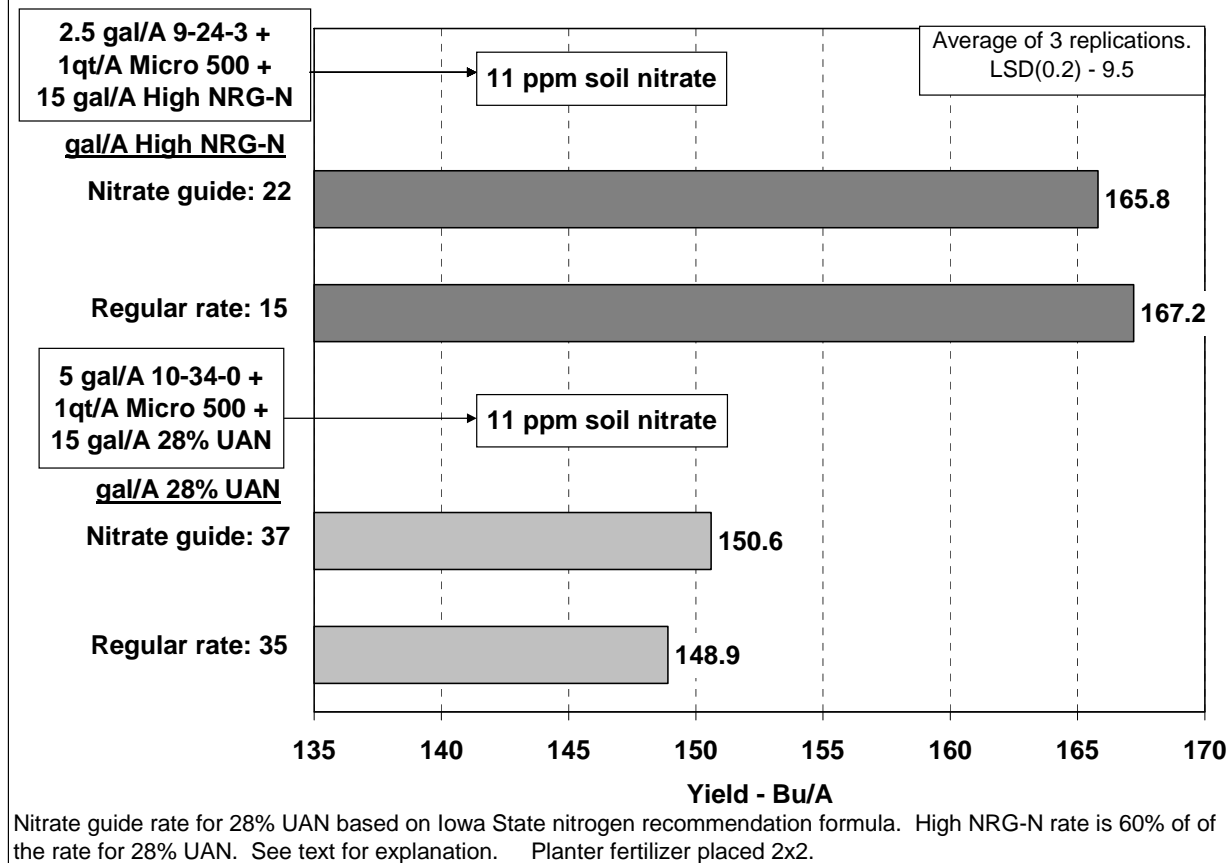


- Although not statistically significant, the “regular” rate of High NRG-N resulted in a higher yield than that with the “nitrate-guide” rate.
- The yield with the “regular” 30 gal/A rate of High NRG-N was significantly higher than either rate of 28% UAN, even though those rates were 17 to 20 gal/A higher.

### **Planter-applied phosphate and nitrogen fertilizer.**

Applying 15 gal/A of either nitrogen fertilizer at planting resulted in increased soil nitrate level. With both nitrogen fertilizers, the balance of the “regular” rate was applied at side-dress: 15 gal/A of High NRG-N (for a total of 30 gal/A) and 35 gal/A of 28% (for a total of 50 gal/A). Again, the nitrate-guide rate for 28% UAN was close to the regular rate: 37 and 35 gal/A. But using the 60% conversion factor for High NRG-N indicated a nitrate-guide rate for High NRG-N of 22 gal/A (37 x 0.6), or 7 more gal/A than the “regular” rate of 15 gal/A. Treatment yield results are in Chart 4.

**Chart 4. Using soil-nitrate test as a guide for side-dress N application**  
**Ag Advisory, Ltd. Elmore, MN - 2002**



- As with the other applications, there was little difference between the yields from the “regular” rates and the “nitrate-guide” rates. The additional 7 gal/A of High NRG-N recommended by the nitrate-guide was not needed.
- Yields with High NRG-N were significantly higher than with 28% UAN.

In conclusion, these results indicate that High NRG-N was superior to 28% at the rates applied. This was confirmed using the nitrate-guide rates. The High NRG-N rate was always 60% of the 28% UAN rate as recommended by the nitrate-guide rate, and yet resulting yields were always higher with High NRG-N, even though 40% less nitrogen was applied.

**Experiment:** High NRG-N Method of Application in Corn  
**Year:** 2004 (04-17)  
**Date of Planting/Harvest:** May 4 / October 27  
**Plot Size:** 4 row x 210 ft. (5 replications)

**Soil Test Levels**

pH: 6.5 CEC : 7.0  
OM: 1.5% P1: 40 ppm  
K: 146 ppm (5.4% K)

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This is the second year of an experiment evaluating different methods of application of High NRG-N on corn. In 2003, there were no significant yield differences between the five methods evaluated, and all methods produced yields significantly higher than an equivalent rate of nitrogen from anhydrous ammonia. The same treatments were applied again in 2004. With a yield goal of 200 Bu/A, a conventional pre-plant application of 210 lb-N/A from anhydrous ammonia was applied. The equivalent rate for High NRG-N would be 42 gal/A.

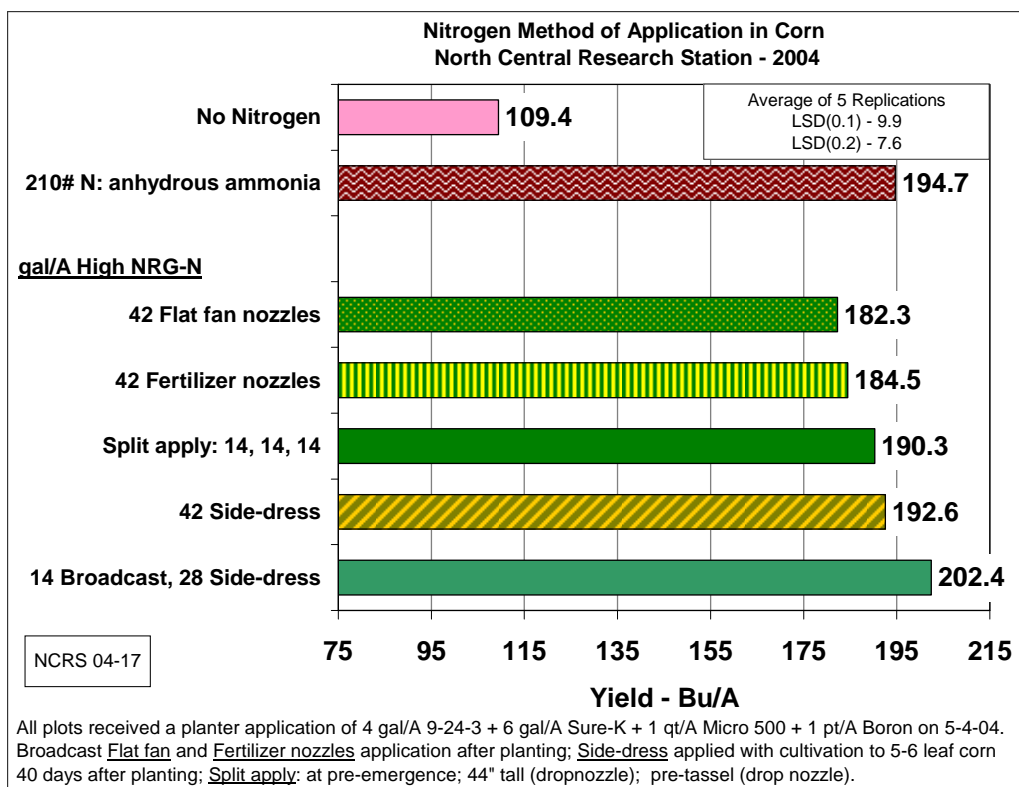
**Objectives:**

Evaluate performance of 42 gal/A of High NRG-N applied:

1. Surface broadcast after planting with standard flat fan nozzles. 1.3 inches of rainfall occurred 2 days after application.
2. Surface broadcast after planting with fertilizer nozzles. Fertilizer nozzles have 20 inch boom spacing and shoot 3 straight streams at an angle to give approximately 6 inch spacing of bands on the ground.
3. 3-Way Split applied: 14 gal/A surface broadcast after planting; 14 gal/A through drop nozzles to 44 inch tall corn; and 14 gal/A through drop nozzles at pre-tassel. This is to simulate multiple applications through irrigation. Recall the rainfall after the first application (see Trt. 1). There was 0.22 inches of rainfall the evening following the second application, and 0.75 inches of irrigation following the third application.
4. Side-dress with cultivation at V5-6 corn stage, 40 days after planting. Application was through the cultivator shovel next to the row.
5. 2-Way Split applied: 14 gal/A surface broadcast after planting (flat fan nozzles) and 28 gal/A applied at side-dress.

All plots received a planter application of 4 gal/A of Pro-Germinator 9-24-3 + 6 gal/A of Sure-K + 1 qt/A of Micro 500 + 1 pt/A of Boron. There was 12.19 inches of rainfall between planting and side-dress, which was 40 days after planting.

Treatment yield results appear in the following chart.



- Unlike 2003, there were yield differences between application methods in 2004, most likely due to the 12.2 inches of rain that fell in the first 40 days following planting.
- Highest yield was with the two-way split application of pre-emergence and side-dress, where the early nitrogen promoted early growth followed by additional nitrogen at side-dress for season-long supply.
- Application of all of the nitrogen in a single application after planting resulted in lower yield likely due to some nitrogen loss from the 12.2 inches of rain in the 40 days after planting.
- The 3-way split application was lower in yield likely due to some nitrogen loss from the pre-emergence application, as the corn was showing some slight N deficiency symptoms (yellowing) at the time of the second application. This again is likely due to the heavy rains, as this has not been seen in similar applications in previous years.
- The 2-way split application of 42 gal/A of High NRG-N produced 202.4 Bu/A, which is at yield goal, with 120 actual pounds per acre of nitrogen. The 194.7 Bu/A from anhydrous ammonia took 210 actual pounds per acre of nitrogen, or 75% more N than with High NRG-N.

### Two-year treatment averages.

We now have two years of data for these treatments.

| High NRG-N Method of Application in Corn. 2003 - 2004<br>North Central Research Station. (NCRS 04-17)      |              |       |         |
|--|--------------|-------|---------|
| Treatment  | Yield - Bu/A |       |         |
|  | 2003         | 2004  | Average |
| 42 gal/A broadcast flat fan nozzles  | 203.8        | 182.3 | 193.1   |
| 42 gal/A broadcast fertilizer nozzles  | 207.3        | 184.5 | 195.9   |
| 42 gal/A 3-way split applied   | 205.5        | 190.3 | 197.9   |
| 14 gal/A broadcast; 28 gal/A side-dress  | 196.8        | 202.4 | 199.6   |
| 42 gal/A side-dress  | 208.1        | 192.6 | 200.4   |
| 210 lb-N/A anhydrous ammonia   | 160.5        | 194.7 | 177.6   |
| no nitrogen  | 153.2        | 109.4 | 131.3   |
| Broadcast: after planting. Anhydrous ammonia: pre-plant.<br>See text for explanation of split application. |              |       |         |

- There was some inconsistency of treatment performance between years, likely due to the heavy early rainfall in 2004. This especially hampered performance of the broadcast treatments, which had high yield in 2003. This may indicate that in years with heavy rainfall following an early application of High NRG-N, that supplemental application may be warranted later in the season.

**Experiment:** High NRG-N and 28% UAN Sidedress Rate Comparison in Corn

**Year:** 1999 (99-25)

**Date of Planting/Harvest:** May 5 / October 20

**Plot Size:** 8 row x 595 ft. (2 replications)

**Soil Test Levels**

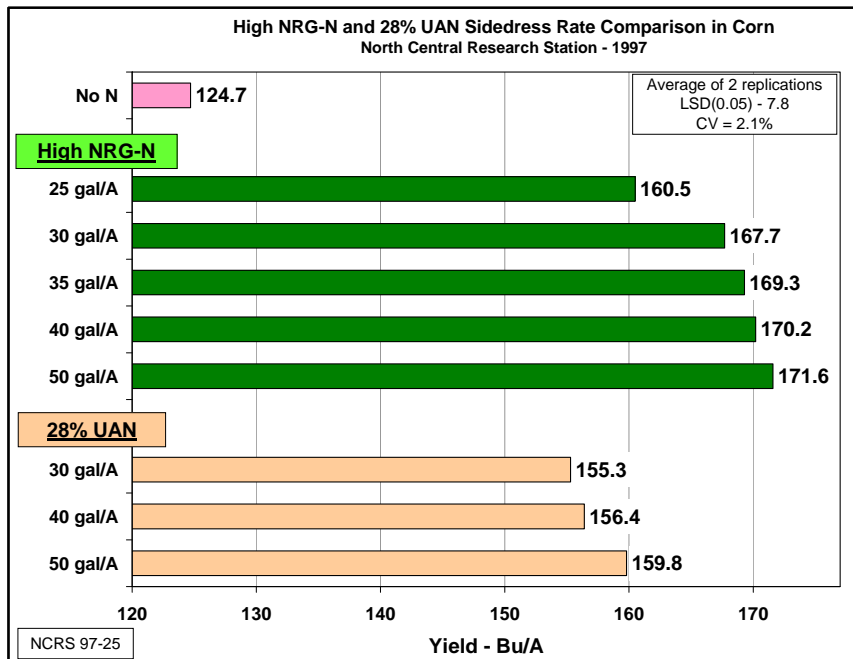
pH: 6.5 CEC: 7.0

OM: 1.7%

P1: 73 ppm K: 91 ppm

Frequent field testing is conducted to prove performance of High NRG-N recommendations compared to those of 28% UAN. Due to formulation differences which enable increased nitrogen efficiency, High NRG-N can be applied at rates 40% lower than rates of conventional nitrogen fertilizers, and yet still have comparable performance. In this experiment, three equal rates of High NRG-N and 28% UAN were compared for effect on corn yield. For this farm in a typical year, 150 lb/A of nitrogen is recommended for a 150 bu/A yield goal. This is 50 gal/A of 28% UAN. A comparable rate for High NRG-N is 30 gal/A (which contains 87 lb of nitrogen per acre.) Both nitrogen fertilizers were applied at 30, 40 and 50 gal/A, with additional rates of 25 and 35 gal/A of High NRG-N. Sidedress applications were made 52 days after planting (corn was 20 in. tall, V8-9), which later than the recommended 30 day interval. The entire field received a planter application of 3 gal/A of Pro-Germinator 9-24-3 + 7 gal/A Sure-K + 1 qt/A Micro 500. The growing season was very favorable for corn with timely rainfall. Yield results appear in the following chart.

- The good growing conditions for the year enabled production greater than the yield goal



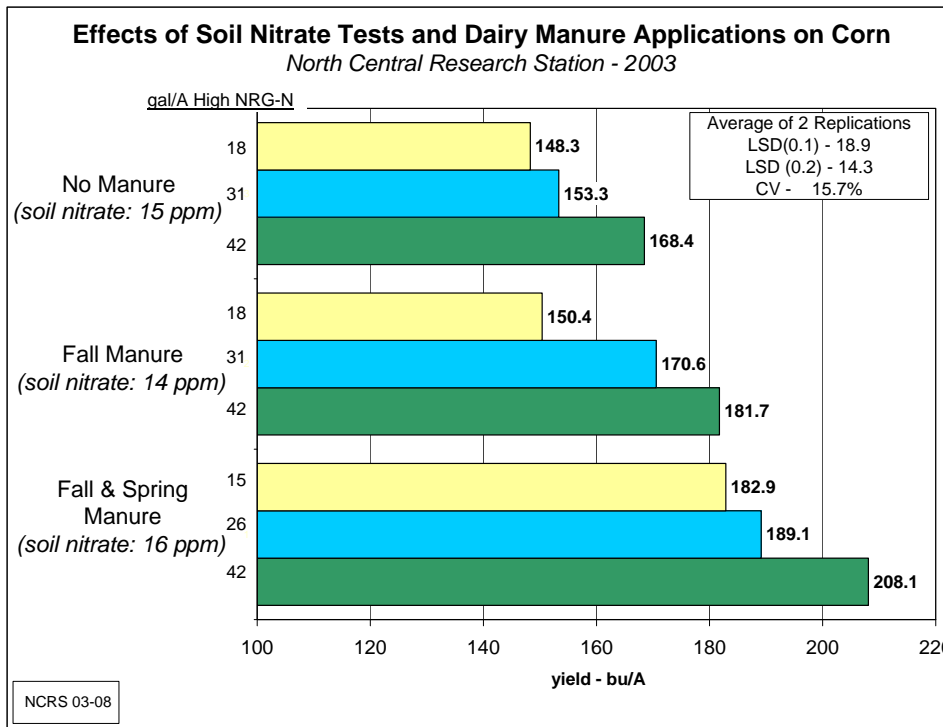
of 150 Bu/A.

- All yields produced were greater with High NRG-N than with 28% at rates of 30 gal/A and higher.
- There was a yield drop off with the 25 gal/A rate of High NRG-N compared to the higher rates indicating that under the conditions, a minimum of 30 gal/A was needed, which is the recommended rate anyway.
- This experiment proves the High Performance benefits found in High NRG-N.

**Experiment:** Manure Applications on Corn  
**Year:** 2003 (03-08)  
**Date of Planting/Harvest:** May 19 / November 20  
**Plot Size:** 20' x 145'

**Soil Test Levels (ppm)**

pH ~ 7.0    P1 ~ 61  
 CEC ~ 8    K ~ 120  
 OM ~ 2.4%    (3.8% K)



Standard rate:

42 gal/A  
 High NRG-N  
 (green bar)

Increased soil nitrate guide rate:

26 or 31 gal/A  
 High NRG-N  
 (blue bar)

Soil nitrate guide rate:

15 or 18 gal/A  
 High NRG-N  
 (yellow bar)

- Dairy manure was applied on this site for 6 years. Applications were done either in the fall, both the fall and spring, or not at all.
- Prior to sidedress soil samples were taken to test the nitrate levels present. Using a formula from Michigan State University, nitrogen rates for the sidedress application were established.
- Nitrate guide tests rates were compared to the standard 42 gal/A rate and a increased rate of the nitrate guide.
- Unlike expected, soil nitrate levels did not vary amongst manure treatments (no manure 15 ppm. fall manure 14 ppm, and fall and spring manure 16 ppm)
- Highest yields were achieved in each manure area with the standard 42 gal/A rate of High NRG-N. Lowest yields were seen when following the soil nitrate guide.
- There was a yield increase at each nitrogen fertilizer rate with the addition of more manure. (Spring was better than none, both fall and spring was better than spring only and no manure.)
- Greatest yield was achieved with fall and spring manure applications put 42 gal/A of High NRG-N at sidedress.

**Experiment:** Liquid Nitrogen Fertilizer Comparison in Irrigated Corn

**Year (Experiment Number):** 2005 (05-10)

**Date of Planting/Harvest:** May 4 / Oct. 19

**Hybrid:** DK50-20 (RR-YGRW)

**Plot Size (replications):** 4 row x 130 ft. (3)

**Previous crop:** soybeans

**Soil Test Levels**

pH: 7.4 C.E.C.: 8.1

OM: 2.0% P1: 43 ppm

K: 85 ppm (2.7% BS)

Nitrogen is usually considered the backbone of corn fertility. Agro-Culture Liquid Fertilizers has sought ways to improve nitrogen efficiency by crops, including corn. High NRG-N does just that through a formulation process that reduces environmental losses (leaching and volatility), enables controlled and extended nitrogen release after application, contains sulfur and other essential nutrients, and is less corrosive to application equipment. Because of improved efficiency, recommended application rates of High NRG-N are up to 40% less pounds of nitrogen per acre compared to conventional nitrogen fertilizers.

High NRG-N is produced through various processes at our three manufacturing plants. However, there is a new nutrient product that is made to be added to conventional UAN solutions to improve nitrogen efficiency of those fertilizers. This product is called eNhance. eNhance allows UAN solutions to be applied at reduced rates with yields comparable to that of full rates. eNhance is a nutritional supplement that combines proprietary chemistry with a proper balance of micronutrients and enzymes to produce a better nitrogen response. It does this by amending the urea and ammonium portions of the UAN solutions reducing volatility and denitrification; causing the nitrogen to be released as the plant needs it. eNhance is added to UAN solutions at a rate of 2 gallons per ton of 28% and 2.25 gallons per ton of 32%. Suggested use rates are for 80% or more of the full rate of application.

An experiment was conducted to evaluate three different application rates: 42, 56 and 70 gal/A of three different nitrogen fertilizers: High NRG-N, 28% UAN and 28% UAN with eNhance. A full rate of nitrogen for corn at the North Central Research Station is 210 lb/A for yield goals in excess of 200 Bu/A. This would be met with 70 gal/A of 28% UAN. Normal comparable rate of High NRG-N at a 60% rate of application would be 42 gal/A. Normal comparable rate of 28% + eNhance at an 80% rate of application would be 56 gal/A. But all of these fertilizers were compared at all three rates.

An additional nitrogen test fertilizer, High NRG-NR was included in this experiment for comparable evaluation. However only one rate was used: 53.3 gal/A. High NRG-NR is a urea-based nitrogen fertilizer, with a nitrogen concentration of 24% and 2.35 lb of N per gallon.

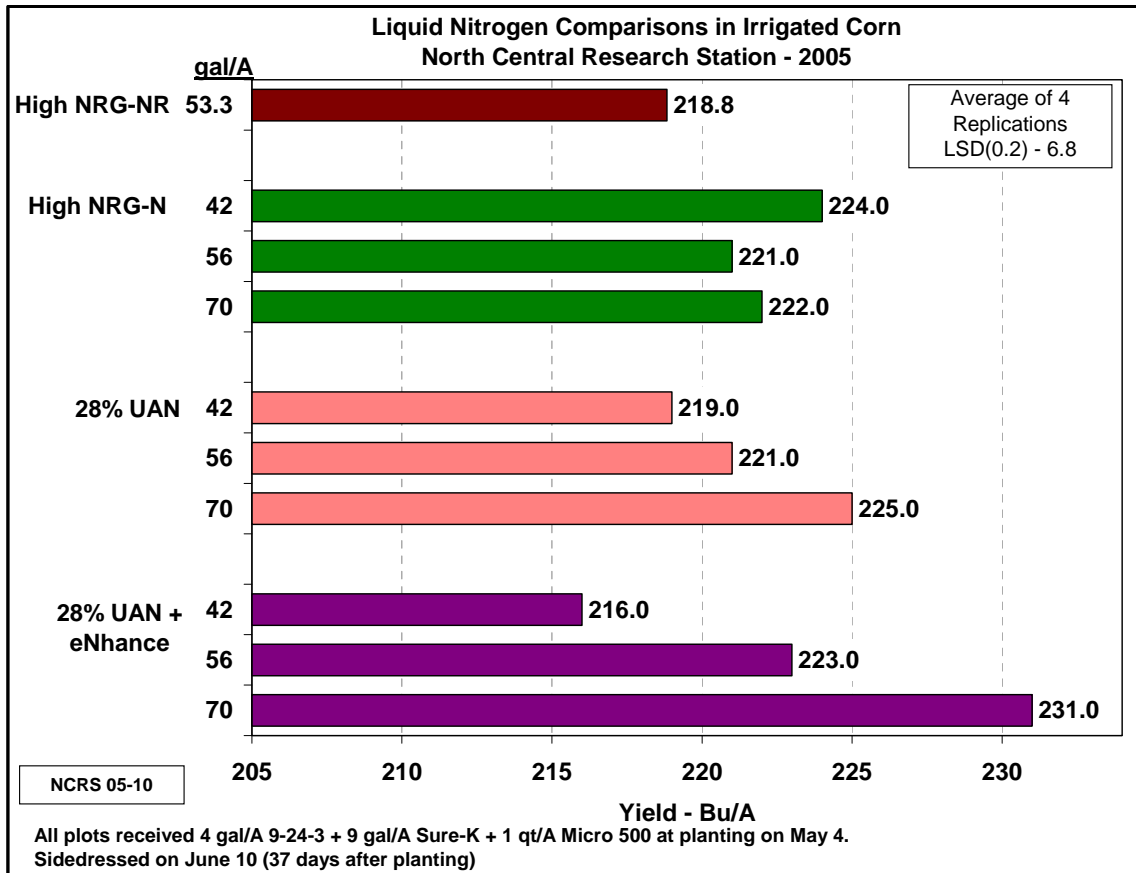
In this experiment, the same planter fertilizer was used for all treatments: 4 gal/A Pro-Germinator + 9 gal/A Sure-K + 1 qt/A Micro 500. The nitrogen treatments were applied as a sidedress 37 days after planting to nine inch tall corn in the V5 stage of growth.

Nitrogen application rate from the treatments is in the following table.

| Pounds per acre of nitrogen applied with different fertilizer rates of application. |                   |          |          |
|---|-------------------|----------|----------|
| Fertilizer  | 42 gal/A          | 56 gal/A | 70 gal/A |
| High NRG-N  | 122               | 162      | 202      |
| 28% UAN*  | 126               | 168      | 210      |
| High NRG-NR   | (53.3 gal/A: 125) |          |          |

\* - N rate is the same with eNhance added

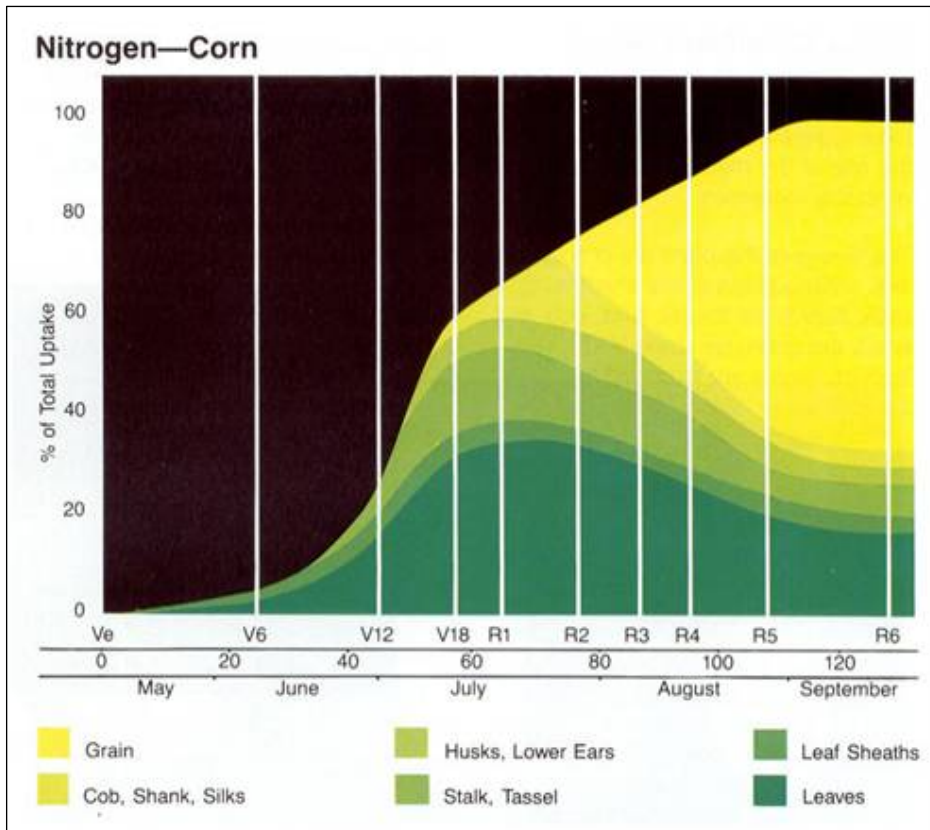
Treatment yields appear in the following chart.



- There was no rate response with High NRG-N, but there was with 28% and 28% + eNhance.
- Highest yield was with the full rate of 28% + eNhance.
- High yields were obtained with all nitrogen fertilizers applying only around 120 lb of nitrogen per acre, which is less than is normally applied.

**Experiment:** Timing of Nitrogen Sidedress on Corn  
**Year (Experiment Number):** 2005 (05-00 and 05-19)

When sidedress is the method of application for nitrogen on corn, logic tells us that consideration should be given to application timing. Nitrogen must be made available to the corn at the time of increasing demand, which is around the V6 stage of growth or 25 days after emergence, which is around 30 to 40 days after planting. The nitrogen accumulation curve is shown in the following graphic.



Seasonal nutrient accumulation of nitrogen in corn. From: *How a Corn Plant Develops. Special Report No. 48. Iowa State University of Science and Technology Cooperative Extension Service Ames, Iowa. 1997.*

As has been shown previously, the nitrogen in the planter-applied fertilizer, such as Pro-Germinator 9-24-3 and Sure-K can meet the early-season nitrogen demand by corn. But sidedress application should be timely to meet the remaining demand.

Two experiments were conducted on two different farms of the North Central Research Station to measure the effects of sidedress timing on corn. One of the experiments was with corn following corn, and the other was with corn following soybeans. The same corn hybrid was used for both experiments.

Nitrogen sidedress application for all three experiments was approximately 30, 40 and 50 days after planting. The fertilizers were applied sub-surface with a cultivator, placed on the shovel next to the row. Nitrogen fertilizers used were:

1. High NRG-N applied at a rate that was 60% of the conventional nitrogen volume.
2. 28% UAN at the 100% conventional nitrogen application rate.

3. 28% UAN + eNhance applied at a rate that was 80% of the conventional volume.

**Farm 1. Corn following corn (05-00)**

**Date of Planting/Harvest:** May 6 / Oct. 21

**Hybrid:** DK50-20 (RR-YGRW)

**Plot Size (replications):** 4 row x 220 ft. (2)

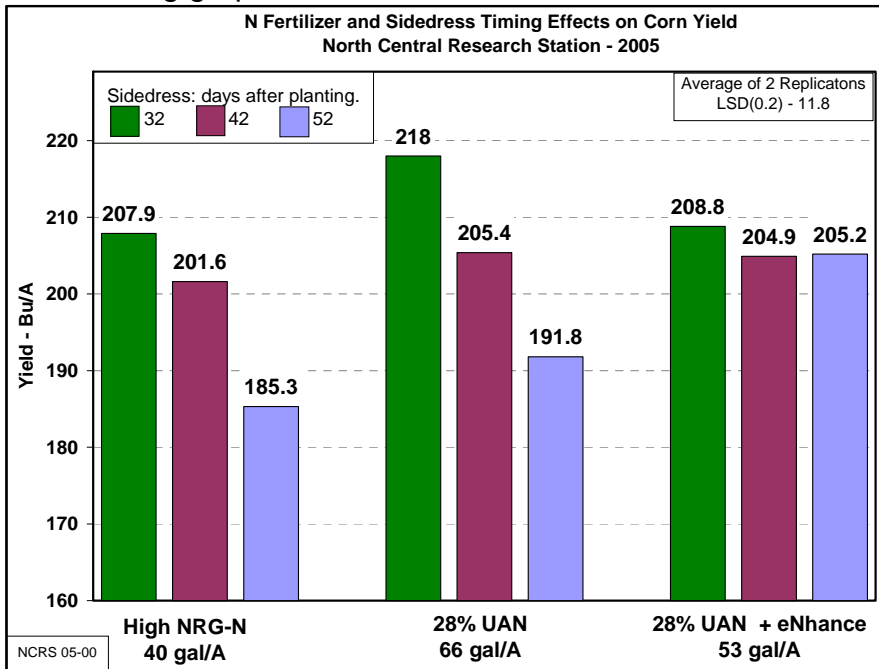
| <b>Soil Test Levels</b> |                     |
|-------------------------|---------------------|
| pH: 6.9                 | C.E.C.: 5.0         |
| OM: 1.2%                | P1: 66 ppm          |
| K: 80 ppm               | N: 5 lb/A (0-6 in.) |
|                         | in fall 2004        |

All plots received the same planter-applied fertilizer: 3 gal/A Pro-Germinator 9-24-3 + 6 gal/A Sure-K + 1 qt/A Micro 500. After the last sidedress application, irrigation trickle tape was laid down and weekly irrigation was implemented.

The following nitrogen rates were used:

| Fertilizer        | gal/A | lb-N/A |
|-------------------|-------|--------|
| High NRG-N        | 40    | 115.6  |
| 28% UAN           | 66    | 198    |
| 28% UAN + eNhance | 53    | 159    |

Sidedress applications were made 32, 42 and 52 days after planting. Yield results appear in the following graph.



- For High NRG-N and 28% UAN, higher yield correlated with the earlier timing of sidedress. But this timing response was not evident with the 28% UAN + eNhance.
- Yields were higher with 28% UAN, although differences were not statistically significant. (Unfortunately there was room for only two replications rather than the normal four, which would have given more data points and less variability.)

**Farm 3. Corn following soybeans (05-19)**

High-Performance Proof 95-08

| <b>Soil Test Levels</b> |                    |
|-------------------------|--------------------|
| pH: 7.6                 | C.E.C.: 8.8        |
| OM: 2.3%                | P1: 44 ppm         |
| K: 123 ppm              | (No N test avail.) |

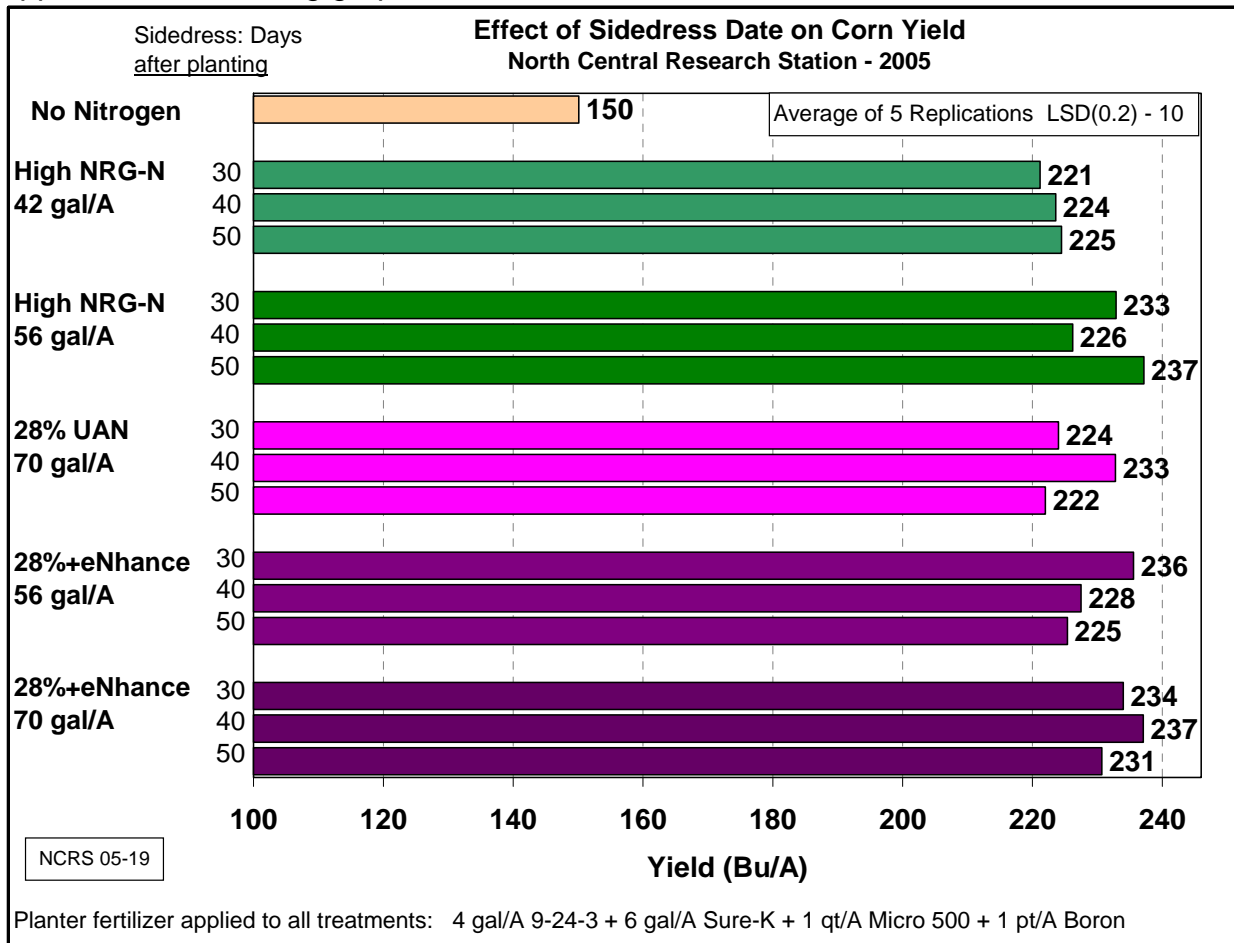
**Date of Planting/Harvest:** May 2 / Oct. 28  
**Hybrid:** DK50-20 (RR-YGRW)  
**Plot Size (replications):** 4 row x 210 ft. Rep 1-3;  
 4 row x 130 ft. Rep 4,5

All plots received the same planter-applied fertilizer: 4 gal/A 9-24-3 + 6 gal/A Sure-K + 1 qt/A Micro 500 + 1 pt/A Boron. Plots were watered with overhead irrigation.

The following nitrogen rates were used:

| Fertilizer        | gal/A | lb-N/A |
|-------------------|-------|--------|
| no N fertilizer   | 0     | 0      |
| High NRG-N        | 42    | 121.3  |
| 28% UAN           | 70    | 210    |
| 28% UAN + eNhance | 56    | 168    |
| 28% UAN + eNhance | 70    | 210    |

Note that this experiment included a full rate of 28% UAN + eNhance as well as a no-nitrogen treatment. Sidedress applications were made 30, 40 and 50 days after planting. Yield results appear in the following graph.



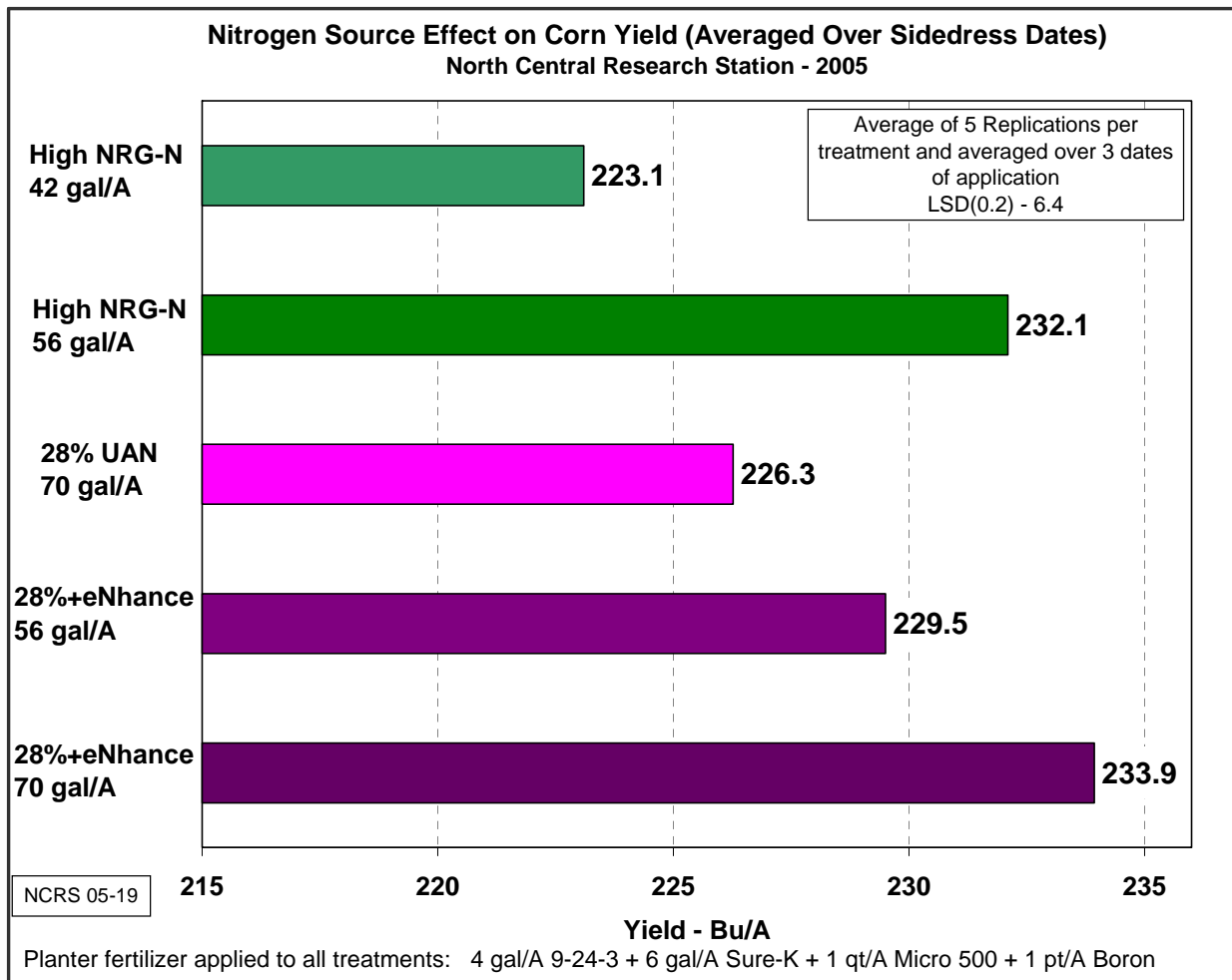
- Generally, all nitrogen treatments yielded very well, and there was no consistent correlation to timing.
- The most consistent fertilizer was the 42 gal/A rate of High NRG-N.

Yield data for all nitrogen treatments was averaged over each sidedress date to see overall effects of date on yield. Results appear in the following table.

| Effect of Sidedress Date After Planting on Corn Yield<br>(Yields averaged over all N treatments for each date)<br><i>North Central Research Station - 2005 (exp. No. 05-19)</i> |               |
|---|---------------|
| Sidedress date<br>(days after planting)   | Yield<br>Bu/A |
| 30  | 230           |
| 40  | 231           |
| 50  | 228           |
| No statistically significant yield differences  |               |

- It was unexpected to have such similar yields from the 20 day span in date of sidedress application. (Note: Each yield number is the average of 25 data points: 5 treatments times five replications per treatment.)

The above example is yield averaged over the different nitrogen treatments to see the effect of date of application. Since there were no significant differences in date, we can average the yields of each nitrogen treatment over the three dates to get a more precise look at the different nitrogen treatments. Results of this are in the following chart.



- There were no statistically significant yield differences between the three recommended use rates of sidedressed nitrogen: 42 gal/A High NRG-N, 70 gal/A 28% UAN and 56 gal/A 28% UAN + eNhance.
- Unlike previous experiments that showed no rate effect with High NRG-N, the 56 gal/A rate yielded significantly higher than the 42 gal/A rate. This yield was higher than the 70 gal/A rate of 28% UAN, although difference was not statistically significant.
- The addition of eNhance to the full 70 gal/A rate of 28% UAN did result in statistically significant yield increase, indicating the efficacy of the eNhance.

Overall, we learned that date of application of sidedress nitrogen is important in corn following corn, and more forgiving in corn following soybeans, likely due to residual soil nitrogen. However, it is suggested to not wait too late as unforeseen delays may really make the application too late to meet the demand curve shown at the start.

### **Nitrate Leaching Comparison Between High NRG-N and 28% UAN. Arise Research & Discovery, Inc. Martinsville, Illinois.**

Offsite movement of applied fertilizer nitrogen is an environmental as well as an economic concern. Nitrogen movement into surface or groundwater is potentially harmful and gives agriculture a bad name. Additionally, nitrogen paid for to feed a crop is wasted when leached

away. It would be a great advantage to producers and the environment if nitrogen fertilizer could be formulated to reduce such loss.

Arise Research and Discovery, an independent research company, has constructed a facility to measure nitrate movement into tile lines as well as surface movement in moving water. The soil series is a Cowden silty clay loam. Plots or “bays”, which measure 12 feet wide by 30 feet long, can hold 4-30 inch rows of corn. Buried 4 feet under the surface of each bay is a tile line which empty into a 36 inch vertical pipe, where a bucket is placed to catch water draining from the tile. This water can then be collected and analyzed for nitrate concentration at each tile-drainage event. The bays are surrounded on the sides by metal walls buried into the soil to prevent contamination from outside the bay. The ground within the bays is on a slight slope so that rainwater will run down the bay into surface water collectors. The vertical pipes at the end of the bays extend above the surface such that surface water will not enter the pipes where the tiles drain. This is the third year of this experiment. The previous two years showed an average 40% less nitrate leaching loss with High NRG-N compared to 28% UAN.

Treatments evaluated are in the following chart.

| Trt. | Rate/A Nitrogen                            | Timing   |
|------|--|--|
| 1.   | 10 gal/A High NRG-N<br>20 gal/A High NRG-N | Pre-plant broadcast and incorporated<br>Side-dress with cultivation 22 days after planting (Corn V6) |
| 2.   | 10 gal/A 28% UAN<br>20 gal/A 28% UAN       | Pre-plant broadcast and incorporated<br>Side-dress with cultivation 22 days after planting (Corn V6) |
| 3.   | 17 gal/A 28% UAN<br>33 gal/A 28% UAN       | Pre-plant broadcast and incorporated<br>Side-dress with cultivation 22 days after planting (Corn V6) |
| 4.   | No nitrogen check                          |  |

Each treatment was replicated three times. Treatments 1 and 2 apply the same volume, 30 gal/A, and approximately the same rates of nitrogen per acre. Treatment 3 applies 50 gal/A of 28%, which would be a typical use rate of 150 lb of N per acre. Thus, treatment 1 and 2 are applying only 60% of the normal rate, which would be a normal rate for High NRG-N. Treatment 4 applies no nitrogen for comparison. Nitrogen was the only fertilizer applied in the experiment. In the previous fall, there was application of 100 lb/A each of 11-52-0 and 0-0-60 over the entire experiment.

The first nitrogen application was on May 17 and the corn was planted two days later. The corn hybrid used was Great Lakes GL6146. There were only four tile water collections. Rainfall amounts between collection dates is shown in the following table.

Rainfall totals between tile drainage collections  
 Arise Research & Discovery. Martinsville, IL - 2004

*First application: May 17*

|  | <u>rainfall</u><br><u>(inches)</u> | <u>collection</u><br><u>date</u> |
|--|------------------------------------|----------------------------------|
| May 17 - June 4<br><i>(side-dressed June 10)</i> | 4.30                               | June 4                           |
| June 11 - June 21                                | 3.15                               | July 1                           |
| July 3 - July 16                                 | 6.50                               | July 19                          |
| July 22 - October 6                              | 6.55                               | October 6                        |

The following pictures explain the plot layout and tile water collection.

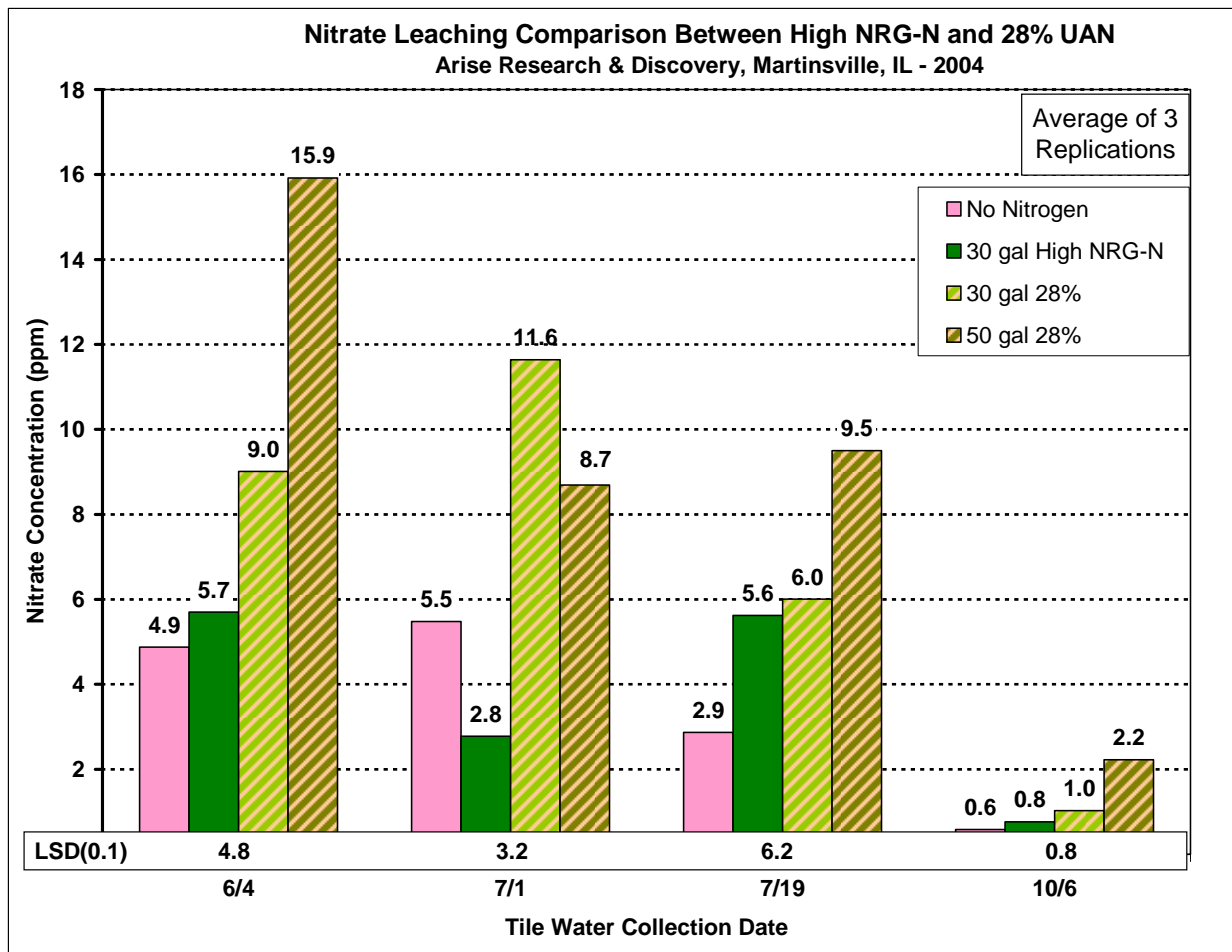


Nitrate leaching collection system. Tile under the plot drains into the collection basin at the front. The basin is normally kept covered.



Looking down into the collection basin where tile output is collected in a bucket for nitrate analysis.

Average nitrate level in tile water from the different treatments appears in the following chart.



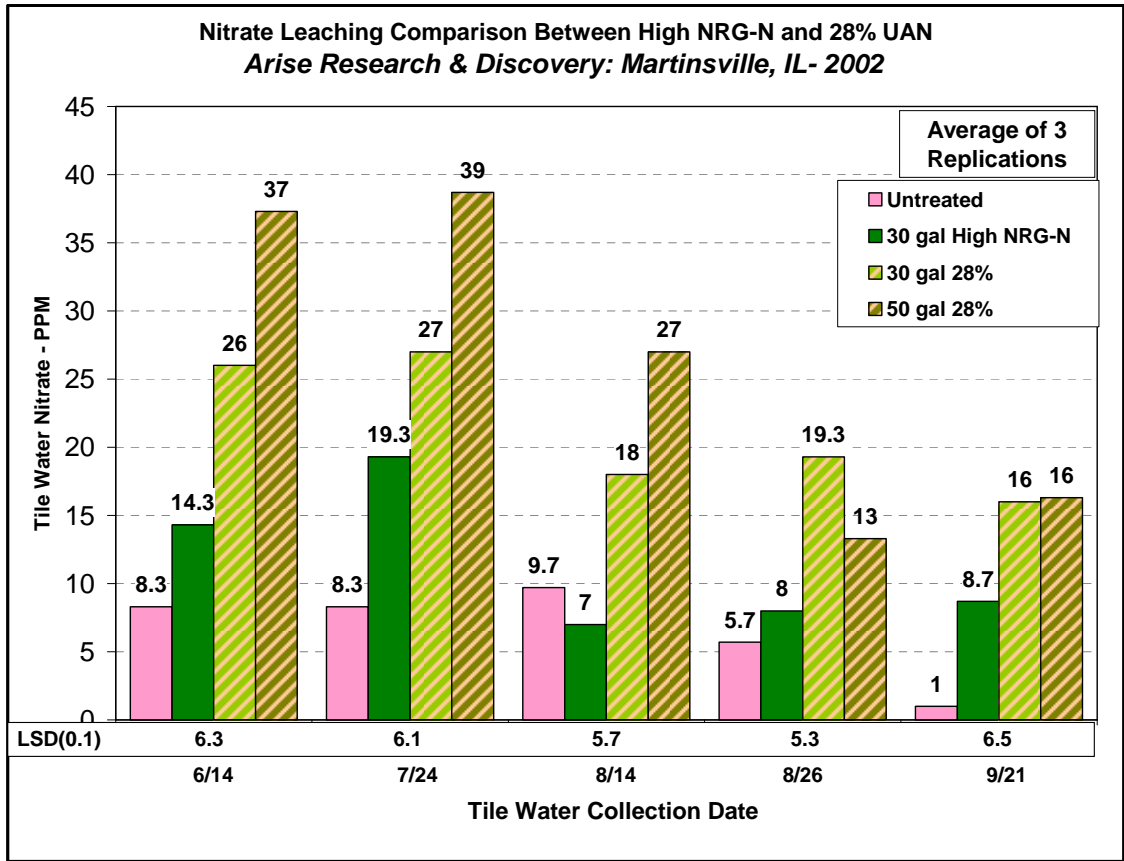
- Nitrate loss through leaching into tile drainage was lower with High NRG-N than with either the equal or normal rates of 28% UAN.
- Nitrate loss levels were substantially lower in 2004 compared to the previous two years. It is felt that this is because the yields obtained in 2004 were so high compared to previous years. Higher than normal yields were seen through the Midwestern corn belt due to favorable growing conditions through the season, and the corn crop made more efficient use of applied nitrogen and less was lost to leaching.

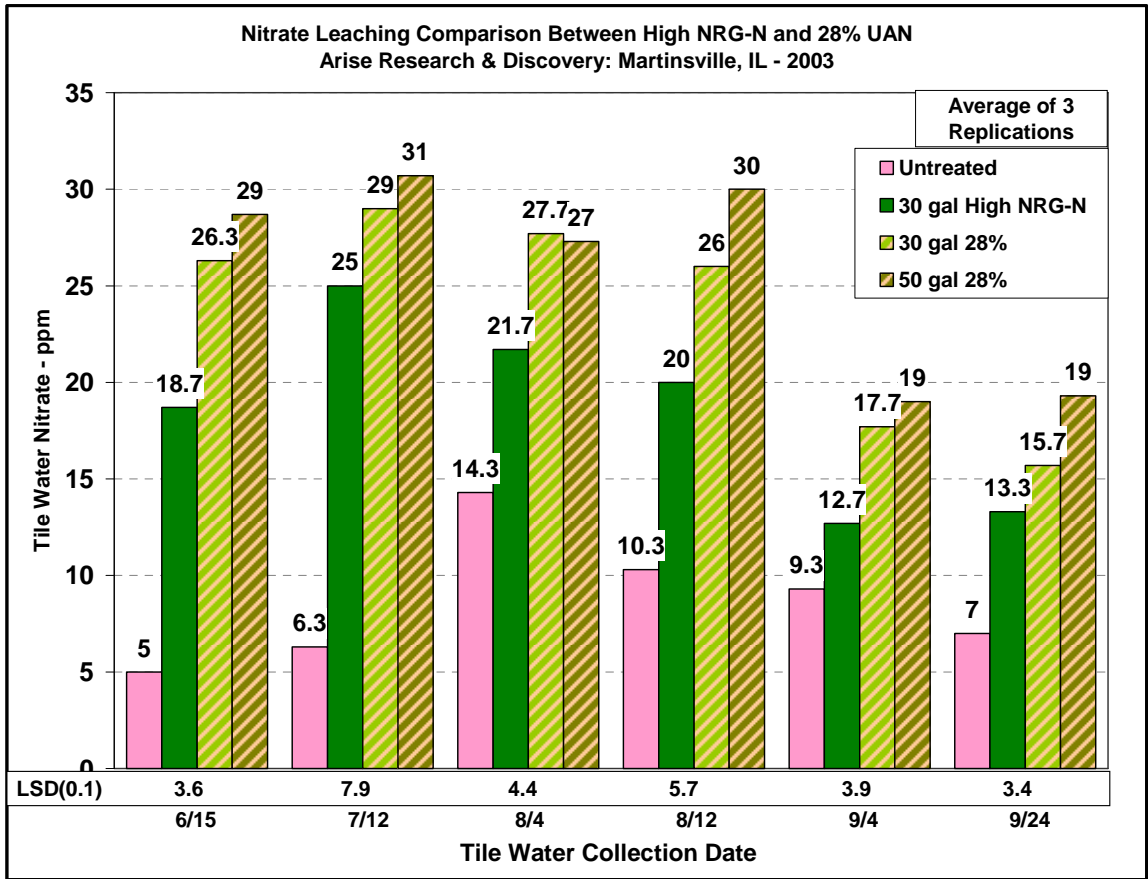
A table showing total nitrate loss and corn yields over the three years of the experiment follows.

| Nitrogen treatment | Total tile nitrates (ppm) |       |      |              | Corn Yield (Bu/A) |       |       |              |
|--------------------|---------------------------|-------|------|--------------|-------------------|-------|-------|--------------|
|                    | 2002                      | 2003  | 2004 | 3 yr avg     | 2002              | 2003  | 2004  | 3 yr avg     |
| 30 gal High NRG-N  | 57.3                      | 111.4 | 14.9 | <b>61.2</b>  | 177.4             | 138.1 | 228.0 | <b>181.2</b> |
| 30 gal 28% UAN     | 106.3                     | 142.4 | 27.7 | <b>92.1</b>  | 160.6             | 126.7 | 223.9 | <b>170.4</b> |
| 50 gal 28%         | 132.7                     | 155.0 | 36.3 | <b>108.0</b> | 165.7             | 136.7 | 224.8 | <b>175.7</b> |
| No Nitrogen        | 33.0                      | 52.2  | 13.8 | <b>33.0</b>  | 73.6              | 92.4  | 124.0 | <b>96.7</b>  |
| LSD(0.05):         | 23.5                      | 23.2  | 8.8  | 18.6         | 15.1              | 15.5  | 13.8  | 14.3         |
| LSD(0.1):          | 18.7                      | 18.5  | 7.0  | 15.4         | 12.0              | 12.3  | 10.9  | 11.9         |

- Highest yield and lowest nitrate loss was from application of High NRG-N. In fact, nitrate loss with High NRG-N was 34% less than the equal rate of 28% UAN, and 43% less than the normal use rate of 28% UAN.
- These results show that formulation differences with High NRG-N involving organic flavonol chelation of nitrogen enable more of the applied nitrogen to stay where it is applied. This partially explains why High NRG-N is effective at rates lower than conventional nitrogen.

Addendum: tile leaching graphs for 2002 and 2003:





## **Nitrogen Fertilizer Enhancement for Corn. ACRES Research, Cedar Falls, Iowa.**

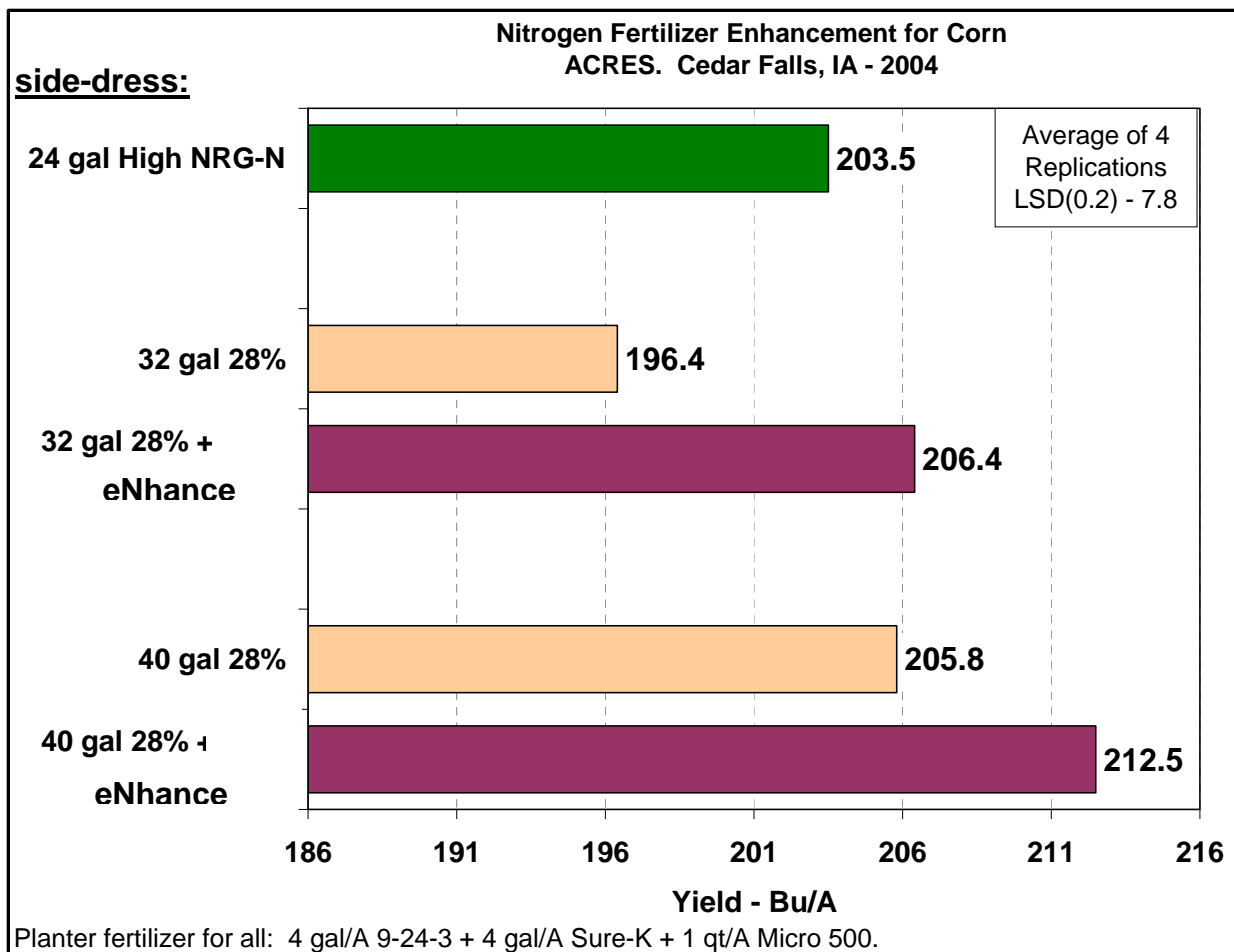
An experiment was established with ACRES to evaluate corn nitrogen fertilizers High NRG-N, 28% UAN and 28% UAN with . eNhance is added to conventional nitrogen solutions to enhance nitrogen performance. eNhance contains sulfur, manganese, and zinc plus enzymes and a chlorophyll-building package. It has some, but not all, of the components that make High NRG-N a more efficient form of nitrogen compared to conventional nitrogen, which can be inefficient under normal growing conditions. Application rate of eNhance is 2 gallons per ton of 28% UAN. (For 32% UAN, apply 2.25 gallons per ton.)

### Objective:

1. Compare High NRG-N, 28% UAN and 28% UAN + eNhance for effects on corn yield.

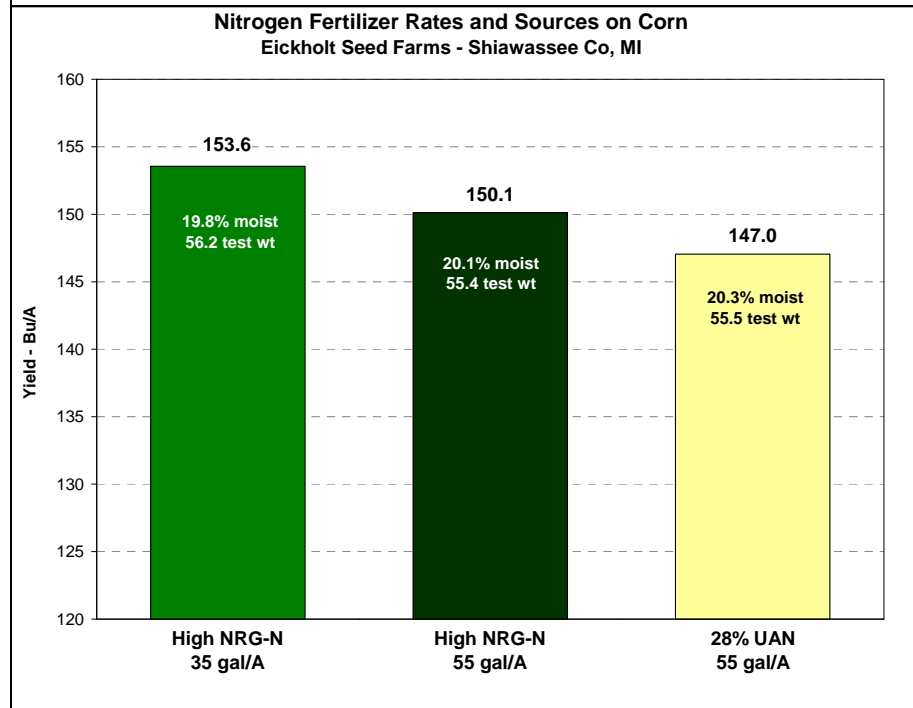
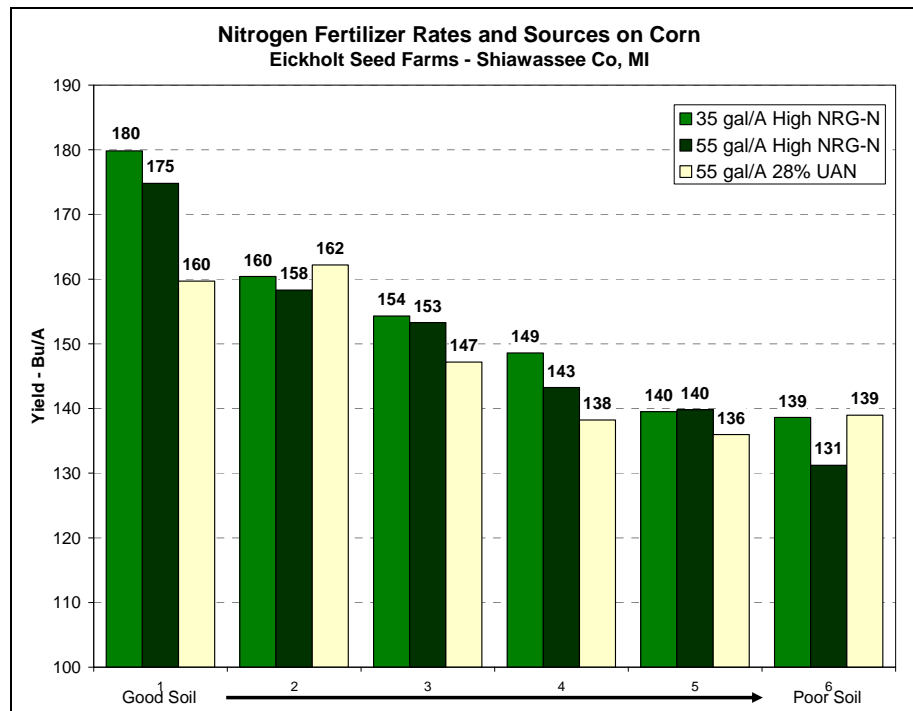
The test site is rich Iowa soil with good yield potential. It is a Floyd loam with 4.5% organic matter and a CEC of 17.6. Normal nitrogen application rate is 120 lb/A, which was the base rate used, or 40 gal/A of 28% UAN. Thus, the comparable rate for High NRG-N was at 60% volume, or 24 gal/A. The previously determined rate for application of 28% + eNhance is at 80% of normal, or 32 gal/A. Additionally, a treatment of 28% + eNhance at the 100% rate (40 gal/A) was included.

Planting date was April 19 with K9310YGCB (Kruger Seed). All plots received the same planter fertilizer: 4 gal/A Pro-Germinator 9-24-3 + 4 gal/A Sure-K + 1 qt/A Micro 500 applied in-furrow. Nitrogen sidedress application was 30 days after planting. The treatments were dribbled on the surface between the rows. Treatment yields were much higher than normal due to the ideal growing conditions: lack of heat stress and adequate moisture. Yields appear in the following graph.



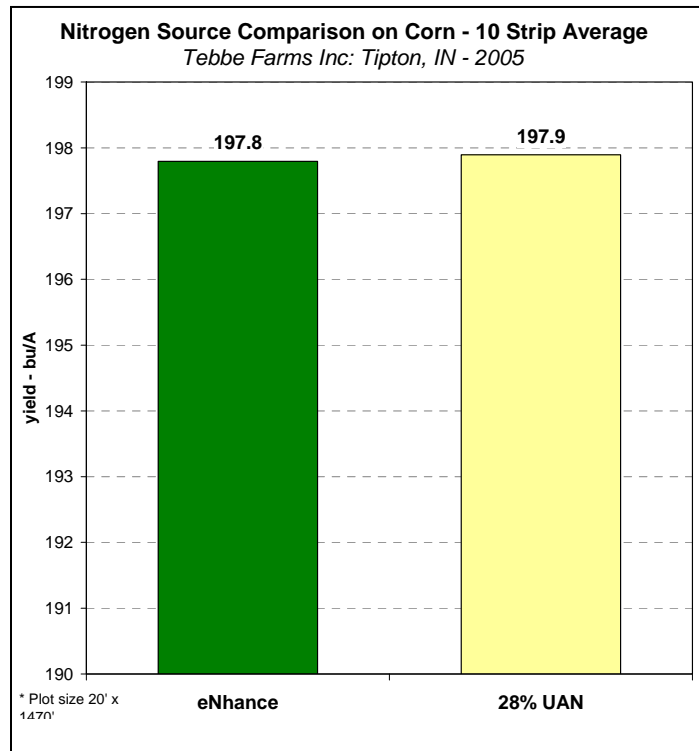
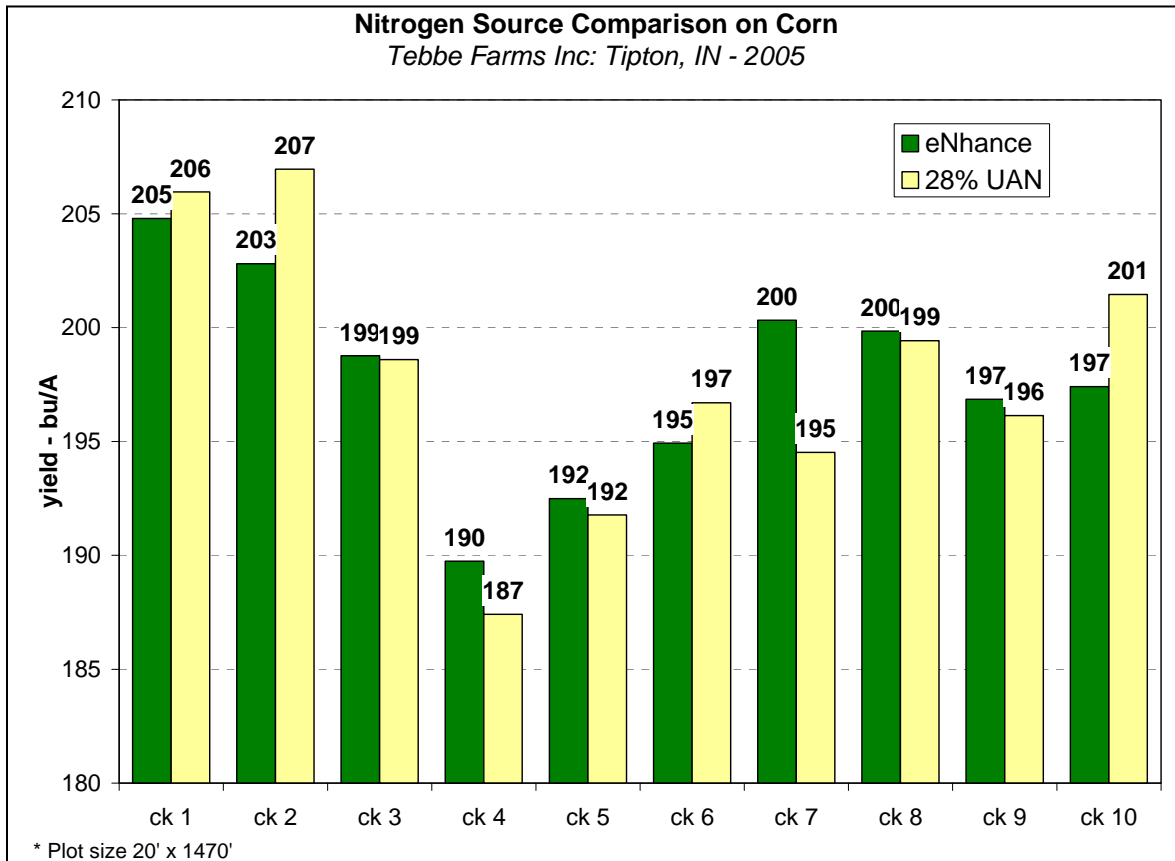
- High NRG-N at the 60% application rate of 24 gal/A performed as well as the 100% rate of 28% UAN.
- There was a significant yield drop off when 28% UAN was applied at the 80% rate or 32 gal/A.
- Addition of eNhance to 28% UAN resulted in yield increases at both the 80% and 100% rates of 28% UAN.
- eNhance offers another alternative to conventional nitrogen application with proven benefits.

**Experiment: Nitrogen Fertilizer Source Comparison on Corn (Michigan)**  
**Year: 2005**



- Two nitrogen sources were evaluated: High NRG-N and 28% UAN
- High NRG-N was applied at two rates: the recommended rate of 35 gal/A and a rate equal to the recommended 28% UAN rate of 55 gal/A
- Multiple stripes of each treatment were done across the field ranging from good soil to average soil
- In most cases, High NRG-N at the recommended rate out yielded the recommended rate of 28% UAN to either side of it.
- There was no advantage to increasing the High NRG-N rate.
- An average of all strips shows High NRG-N at the recommended rate yielded over 6 bu/A higher than the 28% UAN recommended rate.

**Experiment: Nitrogen Source Comparison on Corn – Tebbe Farms, Inc (Indiana)**  
**Year: 2005**

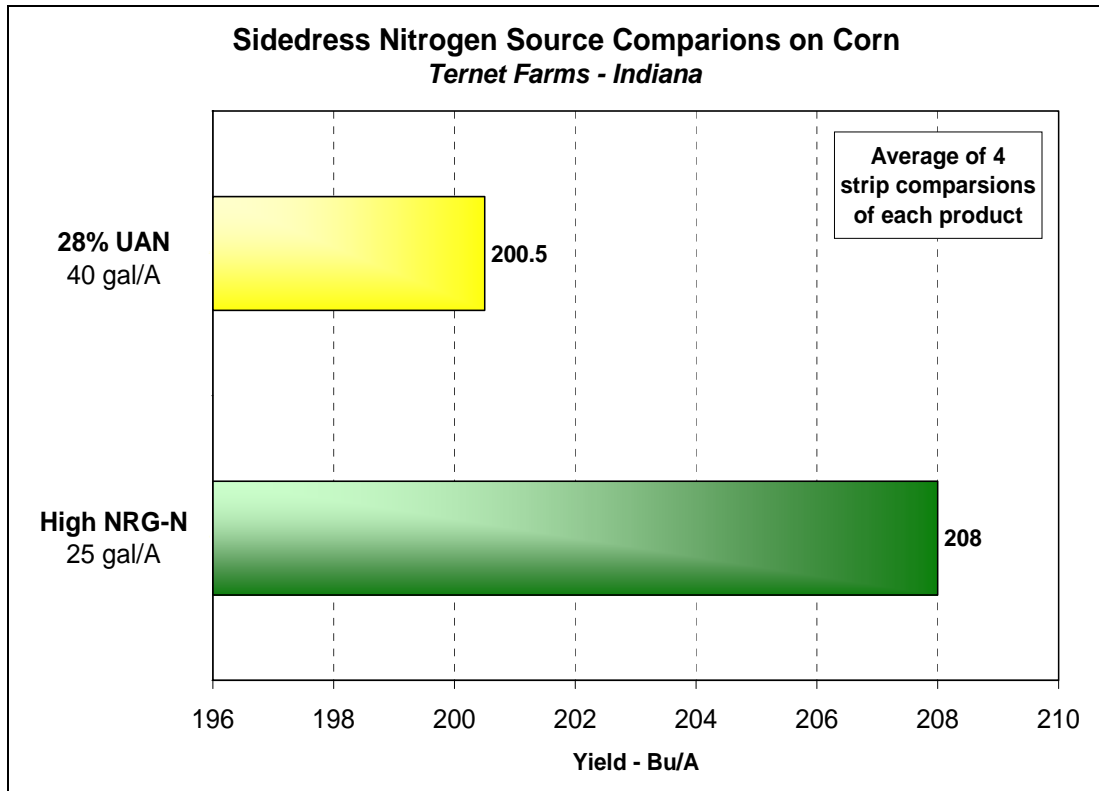


**Results:**

- A nitrogen comparison was done by a grower in Tipton, Indiana.
- Two nitrogen sources were used for this trial: 28% UAN at 60 gal/A and 28% UAN + eNhance a reduced rate of 51 gal/A.
- 10 stripes of each treatment were done across the field.
- Average of all stripes showed no difference in nitrogen source.
- Reducing the rate of 28% UAN with the addition of eNhance provided yields equal to the full rate of 28% UAN alone.

**Experiment: Nitrogen Source Comparison on Corn – Ternet Farms (Indiana)**  
**Year: 2005**

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**Results:**

- This nitrogen comparison was conducted on non-irrigated corn by a grower in northeast Indiana.
- All treatments received 13 gal/A of High NRG-N at planting.
- Two nitrogen sources were used for this trial: 28% UAN at 40 gal/A and High NRG-N at the recommended reduced rate of 25 gal/A.
- Nitrogen was applied sidedress.
- 4 strips of each treatment were harvested across two fields.
- Average of all strips showed over a 7 bu/A yield advantage to the High NRG-N treatment.
- Reducing the application rate allows for more acres to be completed between fill up, while still achieved adequate yields.

**Experiment:** Sidedress Nitrogen Applications in Corn

**Year (Experiment Number):** 2006 (06-303)

**Date of Planting/Harvest:** 4-27-06 / 10-23-06

**Hybrid:** DeKalb 50-20 RR CB

**Plot Size (replications):** 15 ft x 210 ft / 130 ft (5 reps)

**Soil Test Levels (ppm)**

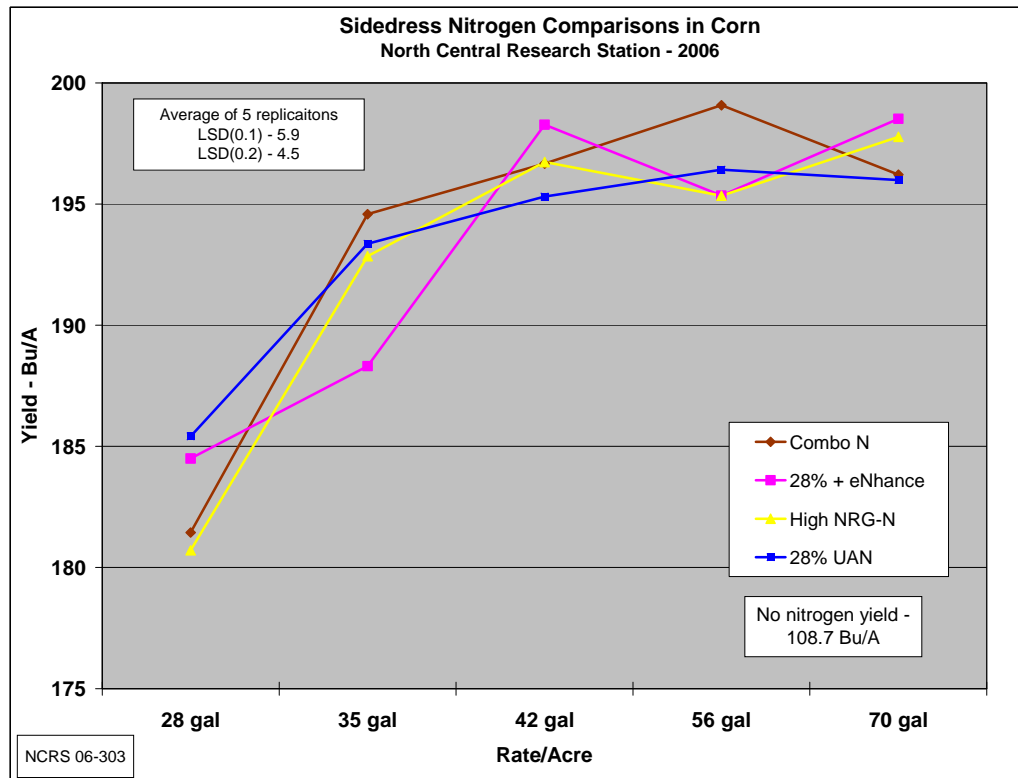
pH: 7.5      C.E.C.: 7.1

OM: 2.6%    P1: 36 ppm

K: 80 ppm (2.9% BS)

**Objective:** Determine the optimal N source rate in corn following soybeans.

Nitrogen continues to be the most studied corn nutrient. With increased energy costs of late leading to increased cost of production of nitrogen fertilizers, careful rate management is necessary for best return on investment. The N sources tested were: High NRG-N, 28% UAN, 28% UAN + eNhance (eNhance added at a rate of 2 gallons per ton of 28%) and Combo N. Combo N is a blend of 50% High NRG-N and 50% 28% + eNhance. All materials were applied as a sidedress treatment at 28, 35, 42, 56 and 70 gallons per acre 46 days after planting to 12-inch corn in the V6-7 stage. Normally the corn would be sidedressed earlier, but it was slow to emerge after the cold and wet month of May. However, this was within the optimum timing window according to previous research of sidedress timing of corn following soybeans. Sidedress application placed the fertilizer midway between the rows through an application knife behind a flat couler. All corn received the same planter fertilizer application of 4 gal/A Pro-Germinator + 6 gal/A Sure-K + 1 qt/A Micro 500 + 1 pt/A Boron. Yield data is presented in the following line graphs.



- Within each gallon per acre rate, there was no significant yield difference, except the application of 28% + eNhance at 35 gal/A. This is probably an anomaly since it was consistent with other treatments at the other rates.

- Generally, the optimum rate was 35 gal/A for all N products, as higher rates did not return significant yield increases. However, these yields are some 10% lower than in 2005 due to the cold May, which delayed emergence. Thus with lower yield potentials, the lower rates were effective.

**Chlorophyll data.** Relative chlorophyll content can be evaluated using a Minolta SPAD meter. Data was collected from replications one through three on July 31 when the corn was in the R1 stage of development. Measurements were taken midway between leaf base and leaf tip on the leaf just below the ear leaf. Twenty leaves were checked, ten from row 3, and ten from row 4, randomly selected within the length of the plot. Treatment averages were calculated. Additionally, the percent of maximum reading was calculated for the average readings. The highest average reading came from the 56 gal/A Combo nitrogen treatment (60.7). The following table lists the average SPAD reading, % of maximum calculation, and the corresponding average treatment yields.

| Effect of nitrogen treatment on chlorophyll readings<br>North Central Research Station - 2006 (NCRS 06-303) |          |      |          |                 |
|---|----------|------|----------|-----------------|
| N source  | gal/A    | SPAD | % of max | Yield -<br>Bu/A |
| High NRG-N  | 28       | 58.5 | 96.3     | 180.7           |
|   | 35       | 58.9 | 97.0     | 192.8           |
|   | 42       | 59.2 | 97.5     | 196.7           |
|   | 56       | 59.0 | 97.2     | 195.3           |
|   | 70       | 60.2 | 99.2     | 197.8           |
| <i>(source average):</i>  |          | 59.1 |          | 192.7           |
| 28% UAN   | 28       | 57.9 | 95.4     | 185.4           |
|   | 35       | 58.4 | 96.2     | 193.4           |
|   | 42       | 60.3 | 99.3     | 195.3           |
|   | 56       | 59.6 | 98.1     | 196.4           |
|   | 70       | 60.5 | 99.6     | 196.0           |
| <i>(source average):</i>  |          | 59.3 |          | 193.3           |
| 28% + eNhance   | 28       | 58.5 | 96.4     | 184.5           |
|   | 35       | 58.9 | 97.1     | 188.3           |
|   | 42       | 60.1 | 99.1     | 198.3           |
|   | 56       | 60.4 | 99.5     | 195.4           |
|   | 70       | 60.4 | 99.5     | 198.5           |
| <i>(source average):</i>  |          | 59.7 |          | 193.0           |
| Combo N   | 28       | 56.9 | 93.7     | 181.4           |
|   | 35       | 58.3 | 96.1     | 194.6           |
|   | 42       | 59.0 | 97.1     | 196.7           |
|   | 56       | 60.7 | 100.0    | 199.1           |
|   | 70       | 60.5 | 99.6     | 196.2           |
| <i>(source average):</i>  |          | 59.1 |          | 193.6           |
| No Nitrogen   | --       | 35.8 | 59.0     | 108.7           |
|   | LSD(0.1) | 2.0  |          | 5.9             |
|   | LSD(0.2) | 1.5  |          | 4.5             |

- The lowest SPAD readings came from the lowest rate of application: 28 gal/A. Although the readings were still 93 to 96% of maximum compared to the no nitrogen treatment, which gave 59% of maximum.
- SPAD readings can be an indication of potential yield keeping in mind that the reading can be relatively high when reduced yield will occur. For example, 28 gal/A of 28% UAN produced an average SPAD reading 95.4% of maximum, but yield was significantly lower than the next higher rate of application (193.4 bu/A with 35 gal/A applied, which gave a SPAD reading of 96.2% of maximum).
- When averaged over SPAD reading for all rates of nitrogen applied within each source, the averages for the four sources tested were all close, as were the yields.
- More work will be done with different N sources, rates and SPAD meter readings in what would be a more “normal” (hopefully) year where yields were not reduced.

**Conclusion:** This year found 35 gal/A of nitrogen to be the optimal rate.

**Experiment:** Effect of Dairy Manure Applications on Fertilizer Rates for Corn

**Year (Experiment Number):** 2006 (06-506)

**Date of Planting/Harvest:** 4-28-06 / 10-24-06

**Hybrid:** DeKalb 5141 RR

**Plot Size (replications):** 15 ft x 140 ft (2 reps)

**Soil Test Levels (ppm)**

See below

**Objective:** Show how manure application changes fertility responses in corn.

A plot area was established in 1997 with three different dairy manure application rates to determine long-term effects on soil and subsequent changes in fertilizer requirements. Fresh dairy manure was applied in three different programs: No Manure, 20 Ton/A Manure in the fall, and 40 Ton/A Manure (20 ton/A in the spring and 20 Ton/A in the fall). Manure is worked into the ground after application.

In the fall of 2004 soil samples were taken to evaluate manure application effects on soil nutrient levels after eight years of manure applications. Soil test results are shown in Table 1.

**Table 1. Soil Analysis After 8 Years of Dairy Manure Applications**

*North Central Research Station - 2005*

| Manure Per Year | P1<br><i>ppm</i> | K<br><i>ppm</i> | %K<br><i>% base. sat</i> | Zinc<br><i>ppm</i> | Org. Matter<br><i>%</i> | CEC<br><i>meq/100g</i> |
|-----------------|------------------|-----------------|--------------------------|--------------------|-------------------------|------------------------|
| No Manure       | 56               | 90              | 3.3                      | 1.2                | 2.1                     | 7                      |
| 20 Ton/A Manure | 60               | 166             | 5.5                      | 1.3                | 2.1                     | 7.8                    |
| 40 Ton/A Manure | 68               | 250             | 8                        | 1.4                | 2.3                     | 8                      |

Surprisingly, there was very little change in the soil phosphorus levels and organic matter where manure had been applied for the past 8 years. There was however, a significant change in the potassium levels where manure was applied. A planter fertilizer program of Pro-Germinator, Sure-K, Micro 500, and Boron was developed for each manure rate according to soil test (see Table 2).

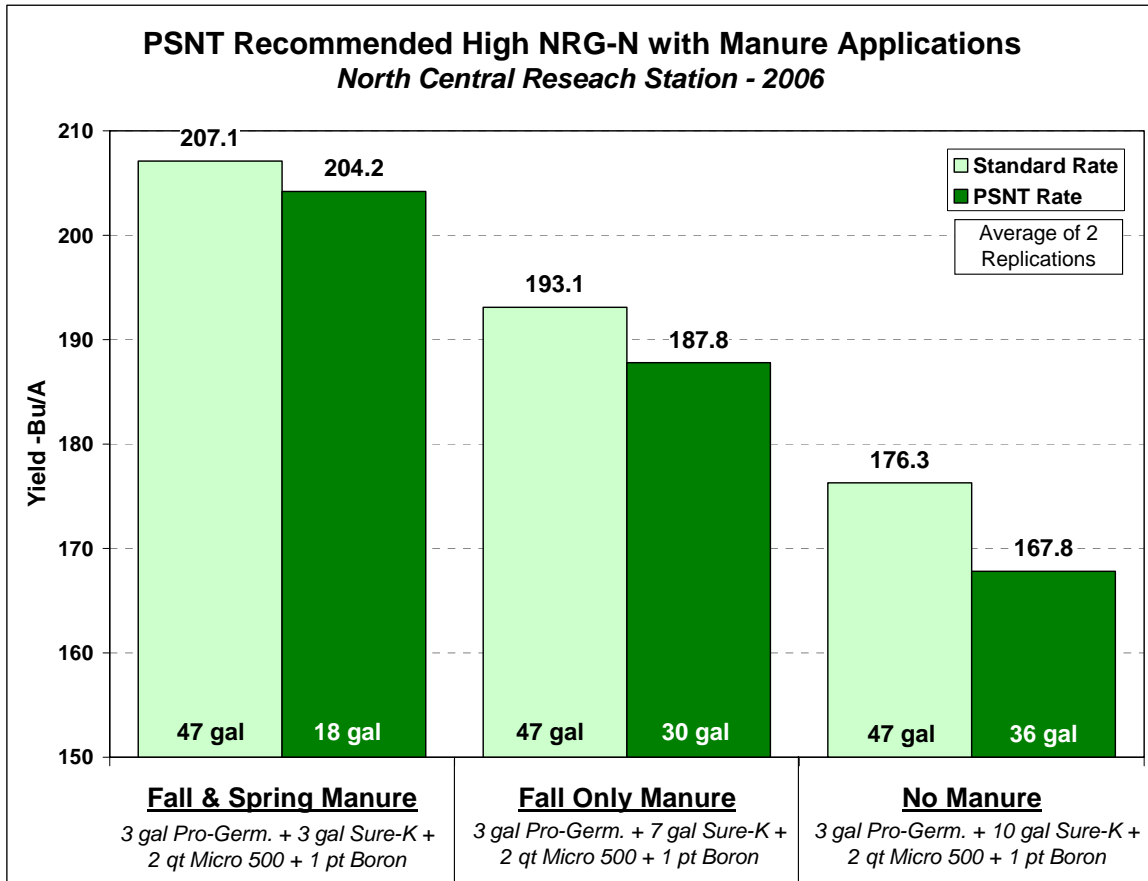
**Table 2. Agro-Culture Liquid Fertilizer Recommendations Based on Soil Test**

*North Central Research Station - 2006*

| Manure per year | Pro-Germ.<br><i>gal/A</i> | Sure-K<br><i>gal/A</i> | Micro 500<br><i>qt/A</i> | Boron<br><i>pt/A</i> |
|-----------------|---------------------------|------------------------|--------------------------|----------------------|
| No Manure       | 3                         | 10                     | 2                        | 1                    |
| 20 Ton/A Manure | 3                         | 7                      | 2                        | 1                    |
| 40 Ton/A Manure | 3                         | 3                      | 2                        | 1                    |

In the 2006 experiment, the Pre-Sidedress Nitrate Test (PSNT) was used to determine the correct nitrogen rate to apply for each manure rate (after 9 years of manure applications). Multiple 12-inch core samples were taken throughout each manure rate

and sent to Michigan State University for analysis and recommendations. The recommended rates of nitrogen were applied as High NRG-N using the equivalence factor of 5 pounds of nitrogen per gallon. These rates were then compared to our standard High NRG-N recommendation of 47 gal/A, which is based on a yield goal of 200 bu/A corn in a continuous corn rotation. Yields appear on the chart below.



**Summary:**

- Due to excessive cold and rainfall in May following planting, overall yields were some 10% lower in 2005 compared to previous years.
- Highest corn yield was achieved with the fall and spring manure applications with the standard 47 gal/A of High NRG-N. However, there was only a 3 bu/A yield advantage when compared to the PSNT recommendation of 18 gal/A. Simple economics shows the advantage of using the PSNT.
- Looking at all manure rates, the standard High NRG-N rate of 47 gal/A out yielded the PSNT rate. However, in most price situations the economic return was better using the PSNT rate in each manure rate.
- Yield gaps between the standard and PSNT nitrogen rates became greater with less manure being applied. This could be because of the additional organic

nitrogen in the soil that became usable later into the season that was not available at the time of the PSNT.

- Comparing the yields from each of the manure rates with the standard High NRG-N application, there was a significant yield increase with the more manure applied, even though the planter fertilizer program was adjusted for each manure rate. Again this could be a nitrogen rate response in relationship to the amount of manure being applied. Although when compared to the PSNT, economically there was no advantage to increasing the nitrogen rate.

**Note on economics:** To calculate the economic advantage of the standard rate compared to the PSNT rate (or any reduced rate) see below:

$\underline{x}$  = cost/gal of High NRG-N divided by the price/bu of corn

*example:  $x = \$2.10 \text{ per gal} / \$3.50 \text{ per bu corn } \underline{x} = 0.6$*

*Therefore, for each additional gallon of nitrogen you apply you must gain 0.6 bu/A in yield.*

### **Economic advantage in the 2006 manure study**

Table 3 shows the increased nitrogen rate (standard rate minus PSNT rate) in gallons per acre along the left hand side of the table. Nine  $\underline{x}$  values make up the different columns along the top of the table. This value is calculated (as show in the example above) by dividing the price per gallon of High NRG-N by the price per bushel of corn. The number of increased gallons is then multiplied by the  $\underline{x}$  value. The body of the table shows the number of bushels of corn needed to cover the increased cost of additional gallons of High NRG-N. *Going back to our example above where  $\underline{x} = 0.6$ , in the no manure application treatment an 6.6 bu/A yield increase would be needed to cover the cost of additional fertilizer (standard minus PSNT rate) used in the 2006 study.*

Continuing onto Table 4, the yield increase seen with increasing the fertilizer rate is along the left hand side of the table. The same nine  $\underline{x}$  values are listed along the top. The body of the table shows the economic advantage to increasing the fertilizer rate; this is found by subtracting the number of bu/A needed to cover nitrogen costs in the body of Table 3 from the increased yield seen in the 2006 study. A negative number shows a negative or no economic advantage to increasing the rate of High NRG-N. *Looking at our example,  $\underline{x} = 0.6$ , the only manure treatment that shows and economic advantage to increasing the High NRG-N rate is where no manure has been applied. Although both manure treated plots showed a yield increase, this increase did not cover the extra nitrogen costs.*

Table 3.

| Manure Rate | Increased N rate | ----- x = \$ per gal / \$ per bu -----          |       |      |       |      |       |      |       |      |       |    |
|-------------|------------------|---|-------|------|-------|------|-------|------|-------|------|-------|----|
|             |                  | 0.5   | 0.55  | 0.6  | 0.65  | 0.7  | 0.75  | 0.8  | 0.85  | 0.9  | 0.95  | 1  |
|             |                  | ----- bu/A needed to cover nitrogen costs ----- |       |      |       |      |       |      |       |      |       |    |
| 40 Ton/A    | 29               | 14.5  | 15.95 | 17.4 | 18.85 | 20.3 | 21.75 | 23.2 | 24.65 | 26.1 | 27.55 | 29 |
| 20 Ton/A    | 17               | 8.5   | 9.35  | 10.2 | 11.05 | 11.9 | 12.75 | 13.6 | 14.45 | 15.3 | 16.15 | 17 |
| No Manure   | 11               | 5.5   | 6.05  | 6.6  | 7.15  | 7.7  | 8.25  | 8.8  | 9.35  | 9.9  | 10.45 | 11 |

Table 4.

| Manure Rate | Yield Increase | ----- x = \$ per gal / \$ per bu -----           |        |       |        |       |        |       |        |       |        |       |
|-------------|----------------|--|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|
|             |                | 0.5  | 0.55   | 0.6   | 0.65   | 0.7   | 0.75   | 0.8   | 0.85   | 0.9   | 0.95   | 1     |
|             |                | ----- advantage to increased nitrogen rate ----- |        |       |        |       |        |       |        |       |        |       |
| 40 Ton/A    | 2.9            | -11.6  | -13.05 | -14.5 | -15.95 | -17.4 | -18.85 | -20.3 | -21.75 | -23.2 | -24.65 | -26.1 |
| 20 Ton/A    | 5.3            | -3.2   | -4.05  | -4.9  | -5.75  | -6.6  | -7.45  | -8.3  | -9.15  | -10   | -10.85 | -11.7 |
| No Manure   | 8.5            | 3  | 2.45   | 1.9   | 1.35   | 0.8   | 0.25   | -0.3  | -0.85  | -1.4  | -1.95  | -2.5  |

\* negative numbers means no advantage to increasing nitrogen rate.

**Please NOTE:** This is only an example, price per gallon of High NRG-N and bushel of corn need to be accurate in order to make a true comparison. Growers can calculate the  $\underline{x}$  value using local prices and use the additional columns on the charts to better estimate economic return. However, as seen above the only combinations that showed an advantage to increasing the High NRG-N rate was in the no manure rate using an  $\underline{x}$  value of 0.75 or less (which can be achieved with either high corn prices or low nitrogen price). Also note, the larger the number in the body of Table 4, the greater the advantage of increasing the nitrogen rate. Therefore, it is concluded that in this experiment the PSNT recommended rate is the most economical for most nitrogen and corn price situations.

**Experiment:** Nitrogen Source Comparison in Corn (Illinois)

**Year:** 2006

**Location:** Arise Research & Discovery, Martinsville, IL

**Date of Planting/Harvest:** May 30 / October 10

**Hybrid:** Vigoro 52RR and Pioneer 34A17

**Plot Size (replications):** 4 row x 50 ft (4 reps)

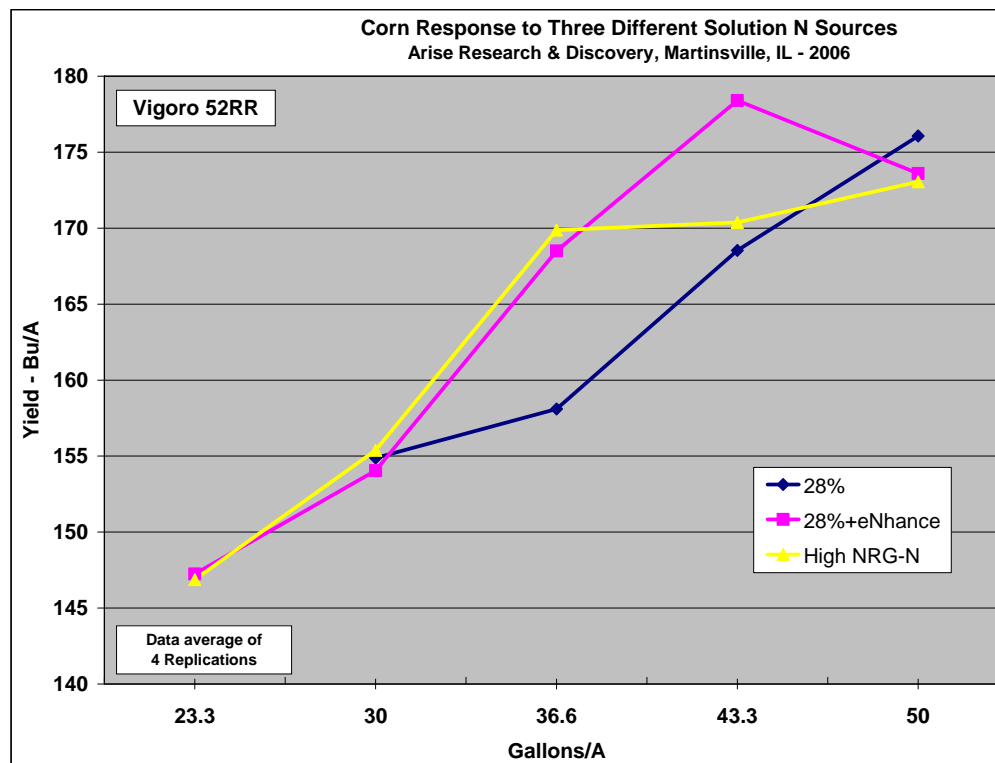
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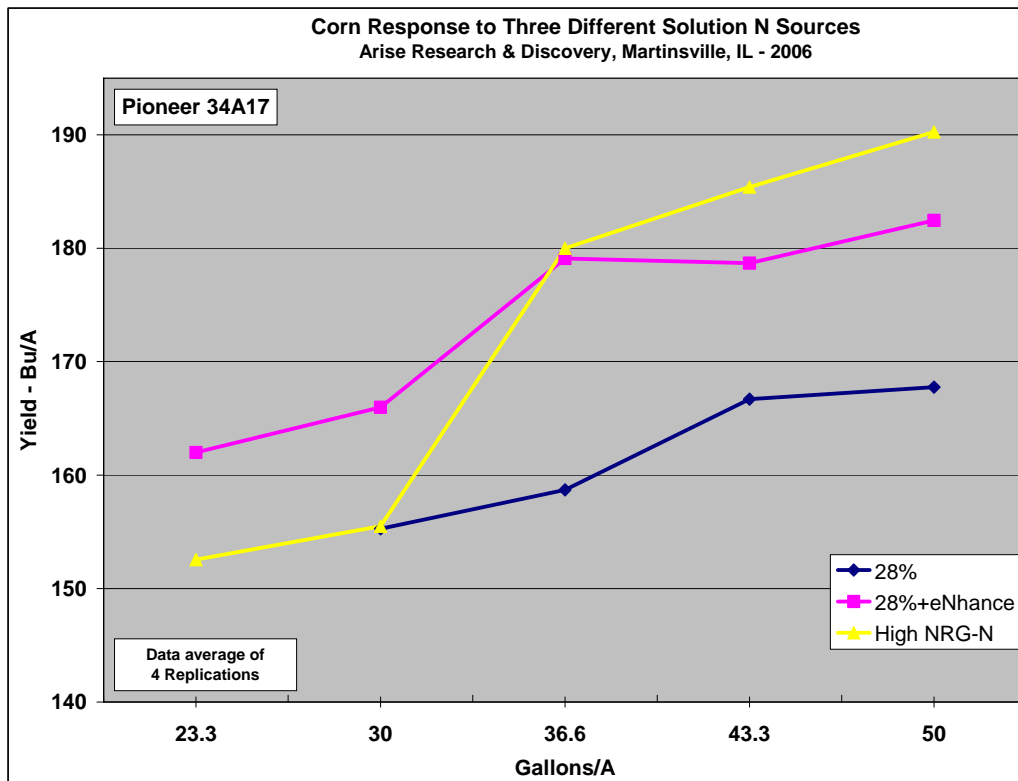
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**Objective:** Determine if three different N sources cause similar yield responses in corn.

With increased nitrogen cost in recent years, there has been renewed interest in investigations of application rate responses for corn yield. Another area of question is whether or not different corn hybrids exhibit similar responses to different nitrogen application rates. An experiment was conducted at Arise Research and Discovery in Martinsville, IL to test three different nitrogen sources at different application rates for yield response in two different corn hybrids.

Nitrogen sources tested were High NRG-N, 28% UAN and 28% UAN with eNhance. The eNhance is an additive for UAN solutions to provide increased nitrogen efficiency and stabilization. It is added at a rate of 2 gallons per ton of 28% UAN. Rate applied were 23.3, 30, 36.6, 43.3 and 50 gal/A for High NRG-N and 28% + eNhance. Rates were the same for the 28% UAN, except for the 23.3 gal/A rate. All treatments were applied as sidedress applications thirty days after planting with a coulter injection applicator. It should be noted that the late planting date was due to 9.3 inches of rain which fell during the six weeks prior to planting. An application of 200 lb/A of 0-0-60 was applied preplant broadcast and incorporated to the entire experimental area. Yield results appear in the following two line graphs.





- There was a differential response to the three N sources between the hybrids.
- In both hybrids, at the middle rate of application (36.6 gal/A), both High NRG-N and 28% + eNhanse had higher yield than did 28% UAN.
- With the Pioneer 32A14, all rates of High NRG-N and 28% + eNhanse at 36.6 gal/A and higher yielded significantly higher than 28% UAN.
- With the Vigoro 52RR, there was a linear correspondence between yield and application rate as yield increased with increased rate of application. Yield with High NRG-N peaked with 36.6 gal/A. Yield with 28% + eNhanse peaked at 43.3 gal/A.
- The greater yields obtained at lower rates with High NRG-N and 28% + eNhanse compared to 28% UAN indicate higher nitrogen efficiency.

**Experiment:** Corn Yield Response to Source and Rate of Fluid Nitrogen

**Cooperators:** Dr. Gyles Randall and Jeff Vetch, University of Minnesota, Southern Research and Outreach Center, Waseca, MN

**Year:** 2006

**Plot Size (replications):** 4 row x 50 ft. (4 replications)

**Note:** the final written report had not been received at the time of this writing, so it will be inserted in a future revised edition. Data presented are from the preliminary yield report, but did not include dates and other details.

**Introduction** (as written by the cooperators in project proposal)

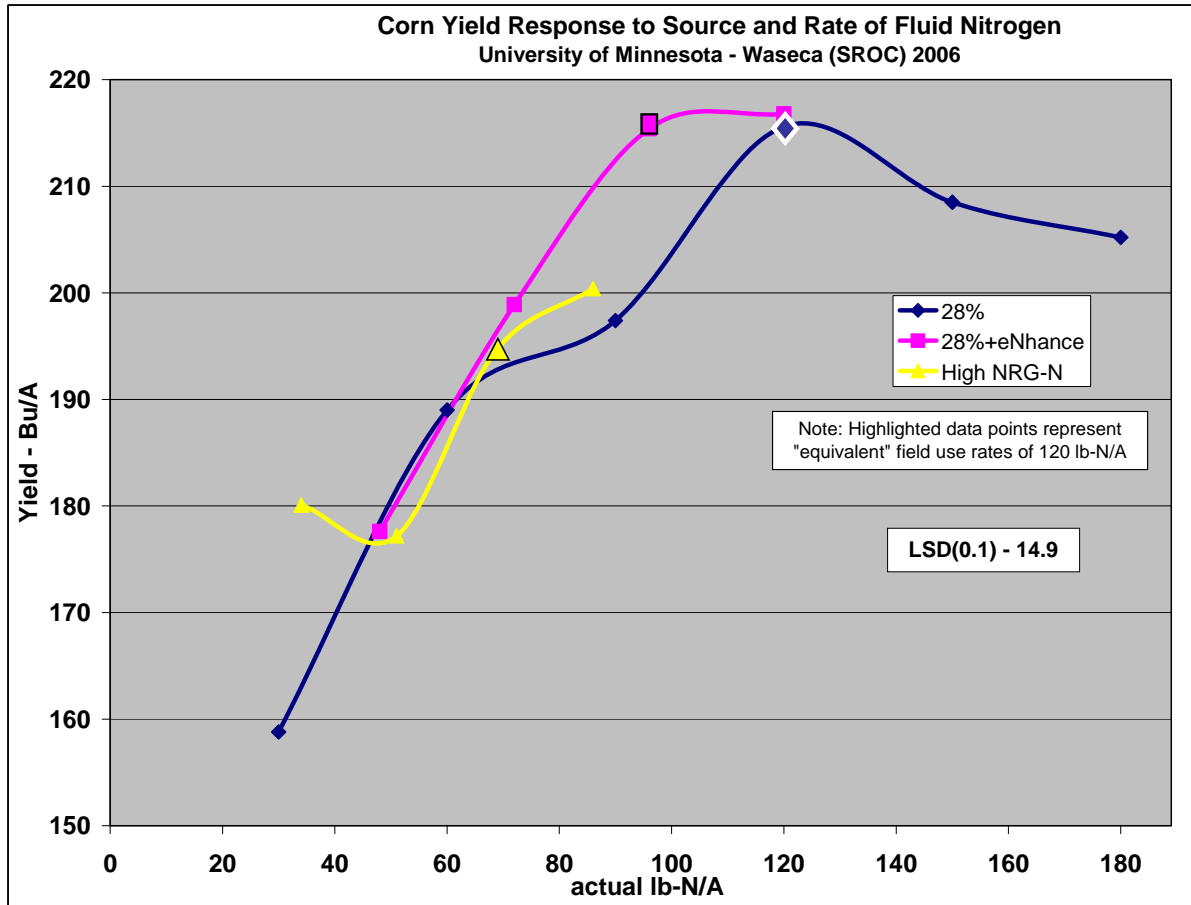
Nitrogen (N) is an essential plant nutrient that is generally the most limiting nutrient for corn production. It is also applied for the 50+ million acres of corn in the Corn Belt in greater quantities than any other nutrient. With increasing emphasis on spring split application and decreasing usage of anhydrous ammonia, fluid fertilizer N (28% UAN) is gaining a larger share of the N market. This is particularly true for split and sidedress application strategies.

A range of application rates of the three nitrogen sources was planned. The sources were: 28% UAN, 28% + eNhance and High NRG-N. As both High NRG-N and 28% + eNhance are promoted as providing enhanced nitrogen, the rates applied were based on increased nitrogen equivalence. For example, High NRG-N is promoted as being as effective at a 60% rate of application compared to a full rate of 28% UAN. The addition of eNhance to 28% UAN at a rate of 2 gallons per ton is promoted as making this combination product as effective at an 80% rate of application compared to a full rate of 28% UAN. Actual rates of application (in gallons per acre), pounds of actual N applied and “equivalent” pounds of N applied for High NRG-N and 28% + eNhance appear in the following table.

| <b>Nitrogen source application rates for corn</b>      |           |           |           |            |            |                   |
|--|-----------|-----------|-----------|------------|------------|-------------------|
| Univ. of Minnesota Southern Research & Outreach Center |           |           |           |            |            |                   |
| <b>28% UAN:</b>  | <b>10</b> | <b>20</b> | <b>30</b> | <b>40</b>  | <b>50</b>  | <b>60</b> gal/A   |
|  | <b>30</b> | <b>60</b> | <b>90</b> | <b>120</b> | <b>150</b> | <b>180</b> lb-N/A |
| <b>28%+eNhance</b>                                     |           | <b>16</b> | <b>24</b> | <b>32</b>  | <b>40</b>  | gal/A             |
|  |           | <b>48</b> | <b>72</b> | <b>96</b>  | <b>120</b> | lb-N/A            |
| <b>(3.75 lb equiv. N/gal)</b>                          |           | <b>60</b> | <b>90</b> | <b>120</b> | <b>150</b> | lb-equiv.N/A      |
| <b>High NRG-N</b>                                      |           | <b>12</b> | <b>18</b> | <b>24</b>  | <b>30</b>  | gal/A             |
|  |           | <b>34</b> | <b>51</b> | <b>69</b>  | <b>86</b>  | lb-N/A            |
| <b>(5 lb equiv. N/gal)</b>                             |           | <b>60</b> | <b>90</b> | <b>120</b> | <b>150</b> | lb-equiv.N/A      |

The “normal” rate of application in this area of Southern Minnesota is 120 lb/A of nitrogen per acre, or 40 gal/A of 28% UAN. Equivalent rates of the test nitrogen sources is 24 gal/A of High NRG-N and 32 gal/A of 28% + eNhance.

Nitrogen sources were applied approximately 30 days after planting with a coulter injection rig. A line graph of corn yields appear in the following graph. (Yields of the normal and equivalent rates are highlighted.)



- Yield of the normal rate of 120 lb-N/A of 28% UAN was 215.6 Bu/A. The 80% equivalent rate of 28% + eNhance yielded 215.4 Bu/A. This equivalent rate of 28% + eNhance (96 lb-N/A) yielded significantly higher than the similar rate of 28% UAN (90 lb/A) which yielded 197.4 Bu/A. This strongly shows the performance advantage of the added eNhance. Yields peaked with these 2 rates.
- The equivalent normal rate of High NRG-N yielded 194.5 Bu/A which was significantly lower than the yields of the full rate of 28% UAN or the 80% rate of 28% + eNhance. The reason for this yield reduction is not clear. However, the yields produced with these relatively low rates of applied nitrogen are quite high. It is remarkable that 120 lb-N/A can produce 215 Bu/A. The reduced equivalent rate of 72 lb of actual N per acre with 24 gal/A of High NRG-N may have put High NRG-N at its limit under these conditions.

**Experiment:** Nitrogen Source and Additive Comparison for Corn

**Year (Experiment Number):** 2008 (08-5089B)

**Date of Planting/Harvest:** May 1 / October 16

**Variety:** DEKALB 5044

**Plot Size:** 15 ft. x 130 ft. (4 replications)

**Soil Test Levels (ppm)**

pH: 7.2 C.E.C.: 8

OM: 1.9% P1: 54 ppm

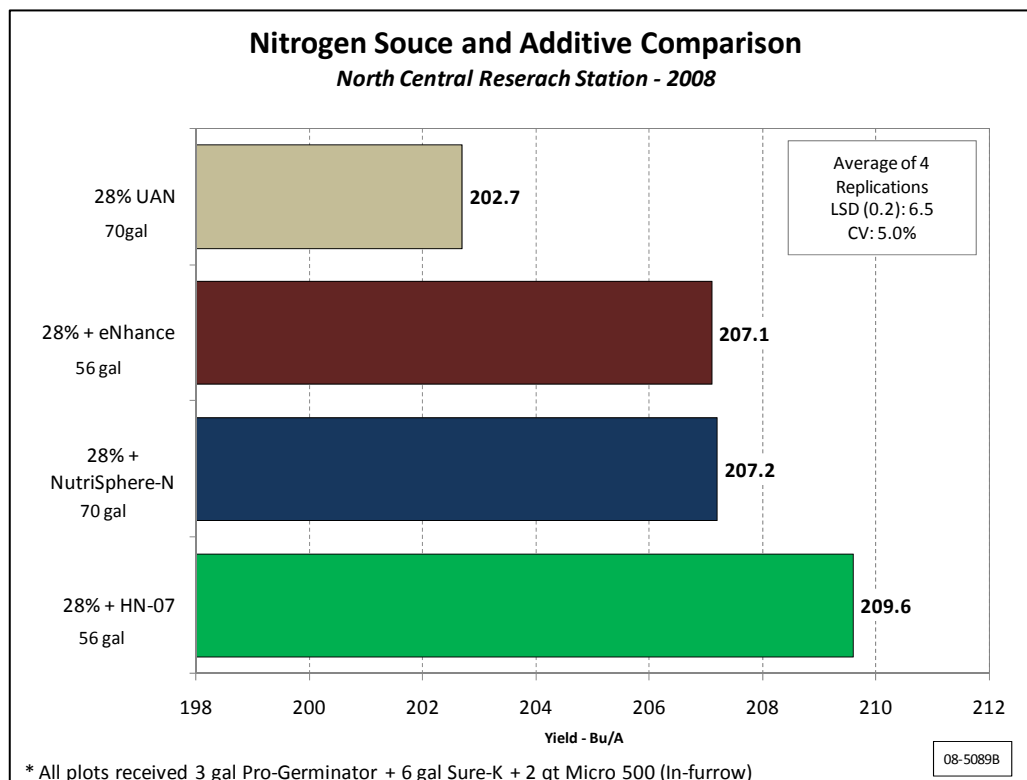
K: 75 ppm (2.4% BS)

**Objective:** Comparison of sidedress nitrogen sources and additives for effects on corn yield.

Since the development of eNhanche, it has become a key product in Agro-Culture Liquid Fertilizers program in a number of areas across the country. Containing sulfur and trace amounts of micronutrients along with proprietary nitrogen stabilizers, eNhanche has performed very well as an additive to conventional UAN solutions. Mixed at 2 gal per ton of 28% UAN (2.25 gal per ton of 32%) application rates can be reduced by 20%, yet still achieve equal or better yields as shown in past research. An experimental product for Agro-Culture Liquid Fertilizers is HN-07. This product is also an additive to conventional UAN solutions and is to be used in soils with a pH above 7.0. Containing 20% sulfur it is mixed at 20 gal/ton of 28% UAN and will also reduce nitrogen application rates by 20% while achieving yields comparable to full rates of 28% UAN alone.

Corn was planted in early May with 3 gal Pro-Germinator, 6 gal Sure-K and 2 qt of Micro 500 applied in-furrow. It was then sidedressed with the different treatments on June 12 when the corn was 10-12 inches tall in the V5 stage of growth. A conventional additive product on the market by Specialty Fertilizer Products (SPF) is NutriSphere-N. According to their website ([www.nutrisphere-n.com](http://www.nutrisphere-n.com)) NutriSphere-N manages nitrogen fertilizer, protecting it, at the molecular level. It controls urease, inhibits unwanted chemical reactions, and protects nitrogen in its ammonium state before it gets converted. This product is mixed with conventional UAN solutions at 0.5% by volume and does not recommend reducing the nitrogen rate.

This replicated sidedress experiment was set up comparing the above listed nitrogen additives at recommended rates to a full rate of 28% UAN alone. A rate of 210 pounds of nitrogen was applied which equals 70 gal/A of 28% or 28% + NutriSphere-N and 56 gal (20% reduced rate) of 28% + eNhanche or 28% + HN-07.



## **Results:**

- All nitrogen additives increased yield over the 28% UAN only.
- NutriSphere-N increased yield by 5 bu/A, from 202.7 to 207.2 bu/A.
- The addition of eNhance increased corn yield by 5 bu/A with 14 gal/A less nitrogen being applied. Yield increased from 202.7 to 207.1.
- Highest yield was achieved with 56 gal of 28% + HN-07 with nearly a 7 bu increase in yield.
- Similar findings occurred in another 2008 sidedress comparison, Experiment 8-515B also in this report.

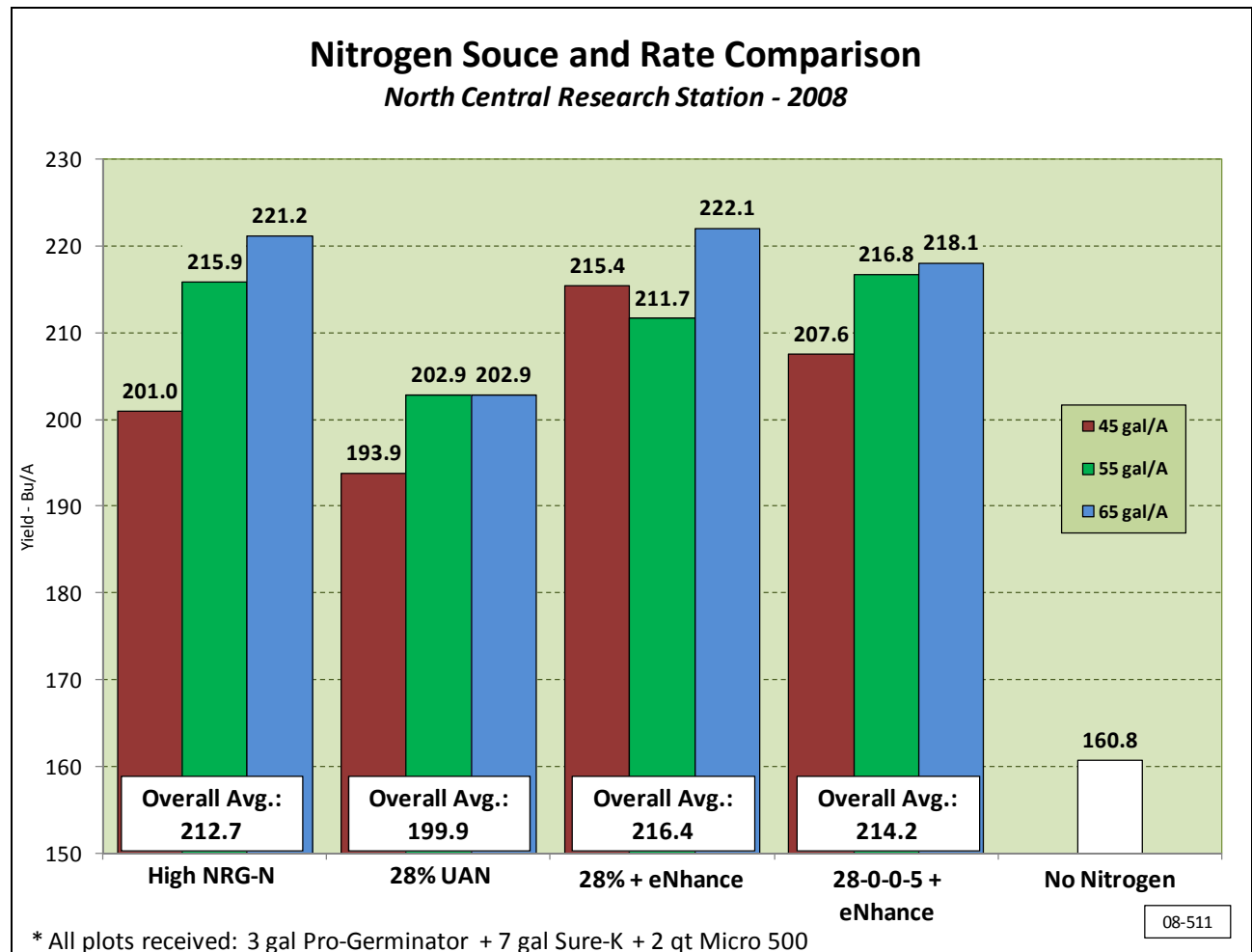
**Experiment:** Nitrogen Source and Rate Comparison in Corn  
**Year (Experiment Number):** 2008 (08-511)  
**Date of Planting/Harvest:** May 5 / October 17  
**Variety:** DEKALB 4660  
**Plot Size:** 10 ft. x 280 ft. (unreplicated)

| <b>Soil Test Levels (ppm)</b> |             |
|-------------------------------|-------------|
| pH: 6.4                       | C.E.C.: 9.7 |
| OM: 2.2%                      | P1: 33 ppm  |
| K: 47 ppm (1.2% BS)           |             |

**Objective:** Field side by side comparison of different nitrogen sources and rates on corn.

With increasing input costs, nitrogen management for corn production is very important to determine the best source and rate to apply to achieve the highest possible yield. Agro-Culture Liquid Fertilizers offers two main options for nitrogen corn programs. First High NRG-N, a 27% nitrogen solution with 1% sulfur. Second is eNhance, this is an additive to conventional UAN solutions with 8.7% sulfur with manganese, zinc and proprietary nitrogen stabilizers to increase nitrogen efficiency.

These plots were planted in early May and all received 3 gal/A Pro-Germinator, 7 gal/A Sure-K and 2 qt/A Micro 500 in-furrow. Nitrogen treatments were sidedressed on June 13<sup>th</sup> when the corn was in the V5 stage of growth and 8 inches tall. Four nitrogen sources were compared, High NRG-N 28% UAN, 28% with eNhance and 28-0-0-5 (32% UAN + ammonium thiosulfate) with eNhance. Three rates of each product were compared; 45 gal, 55 gal and 65 gal which applied approximately 135, 165 and 195 lbs actual nitrogen/A respectively. Results appear on the chart below.



## **Results:**

- All nitrogen treatments greatly increased corn yields over no nitrogen.
- Generally speaking, yields increased with increased nitrogen rates of application.
- The addition of eNhance to 28% UAN at each rate increased yield. As shown in past research, eNhance works as good as or better at the 80% use rate than conventional UAN sources alone and has the potential to increase yield when used at the full UAN rate.
- The nitrogen sources with the highest overall yield averaged over rates was the 28% + eNhance. This averaged over 16 bu/A higher than did the 28% UAN alone.
- Similar overall average yields of all three rates were seen with 28% + eNhance, 28-0-0-5 + eNhance and High NRG-N. The 28% UAN applied alone, was between 12 and 16 bu/A lower than the other three “enhanced” nitrogen sources.

**Experiment:** Nitrogen Sidedress Comparison in Corn

**Year (Experiment Number):** 2008 (08-515B)

**Date of Planting/Harvest:** May 2 / October 15

**Variety:** DEKALB 5044

**Plot Size:** 15 ft. x 140 ft. (unreplicated)

**Soil Test Levels (ppm)**

pH: 6.9 C.E.C.: 13.0

OM: 2.7% P1: 30 ppm

K: 101 ppm (2.0% BS)

**Objective:** Comparison of sidedress nitrogen additives and products.

With increasing costs of nitrogen fertilizers, more and more products are coming on the market to aid in nitrogen stabilization and efficiency. Agro-Culture Liquid Fertilizers High NRG-N has the technology built into the product. **High NRG-N** is an advanced formulation of all the known chlorophyll building elements, of which Nitrogen is the largest, containing 13.5% Stabilized Urea, 6.5% Ammonium, 6.5% Nitrate, 1% Sulfur, and trace amounts of Iron, Magnesium, Manganese and Zinc. This product is very low in free Ammonia and has a total Nitrogen analysis of 27% stabilized with organic compounds and formulated for minimal loss and maximum uptake by plants. With estimated usability greater than 90%, the recommended application rate by comparison to common Nitrogen materials (Ammonia, Urea, UAN Solutions, and Ammonium Nitrate) would be

reduced by 40% to obtain the usability and crop uptake of these common nitrogen sources. Agro-Culture Liquid Fertilizers also have another product, **eNhance**. It does this by amending the urea and ammonium portions of the UAN solutions reducing volatility and denitrification; causing the nitrogen to be released as the plant needs it. When mixed with 28% UAN, 2 gal of eNhance is added per ton of 28% and applied at 80% of the standard nitrogen rate.

Agro-Culture Liquid Fertilizers are always developing and testing new products to add to our current line. An experimental additive evaluated this year was **HN-07**. This product is added to conventional nitrogen solutions at 20 gal per ton and used on soils with a pH above 7.0. Containing 20% sulfur and trace amounts of other nutrients; this product helps increase the uptake and usability of the nitrogen in the plant.

Another product on the market is NutriSphere-N from Specialty Fertilizer Products (SFP). (Following information taken from NutriSphere-N website: [www.nutrisphere-n.com](http://www.nutrisphere-n.com)) NutriSphere-N manages nitrogen fertilizer, protecting it, at the molecular level. It controls urease, inhibits unwanted chemical reactions, and protects nitrogen in its ammonium state before it gets converted. This product is mixed with conventional UAN solutions at 0.5% by volume with no recommended reduction in application rate.

The products listed above along with a full rate of 28% alone were compared in a strip trial using a nitrogen rate of 210 pounds per acre. Products were applied sidedress on June 12 when the corn was 10-12 inches tall and in the V5 growth stage. All treatments received 3 gal Pro-Germination, 6 gal Sure-K and 2 qt Micro 500 in-furrow at planting. Yields appear on the charge below.

**Treatment Sources and Rates**

High NRG-N: 42 gal/A

28% UAN + eNhance: 56 gal/A

28% UAN + HN-07: 56 gal/A

28% UAN: 70 gal/A

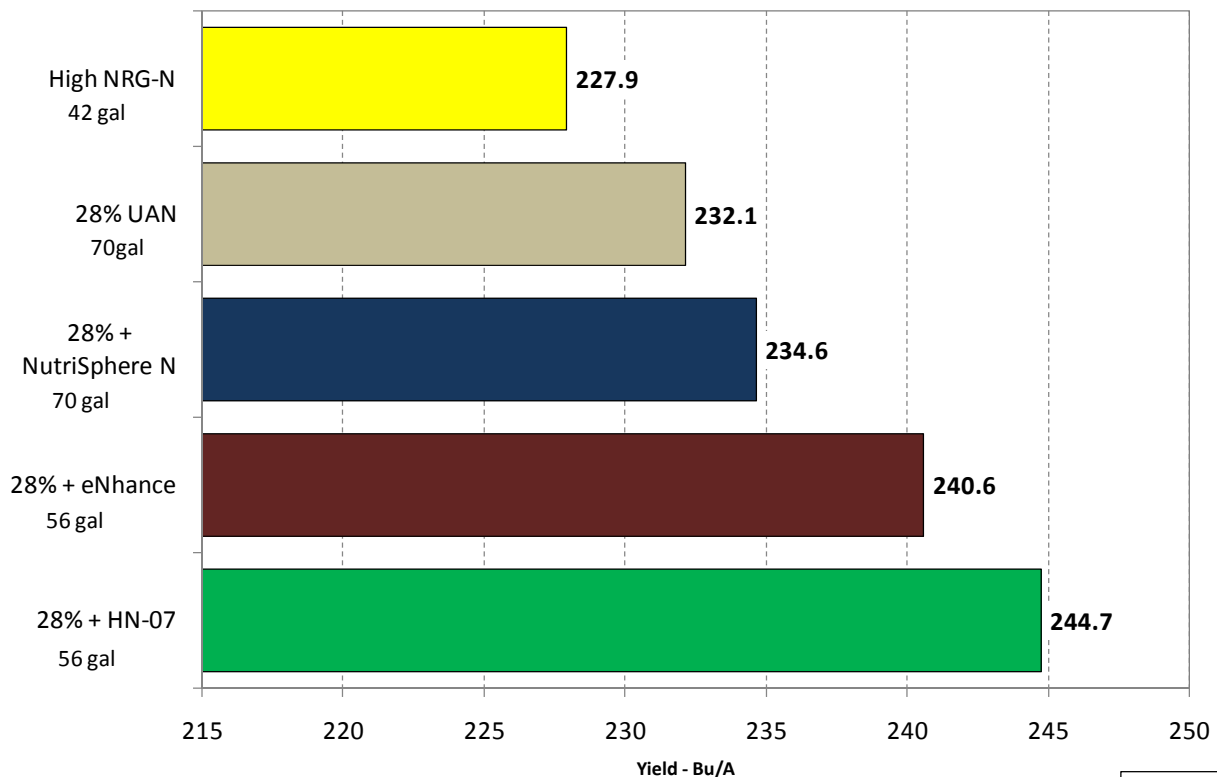
28% UAN + NutriSphere-N: 70 gal/A

Note: all applied at recommendation rates to get equivalent of 210 pounds of nitrogen per acre.

NCRS Sidedress Application



## Nitrogen Souce and Additive Comparison North Central Reserach Station - 2008



\* All plots received 3 gal Pro-Germinator + 6gal Sure-K + 2 qt Micro 500 (In-furrow)

08-515B

### Results:

- High NRG-N application resulted in the lowest yield in this comparison; however, yield was very similar to the full rate of 28% without any additives and applied 28 less gallons per acre.
- All nitrogen additives applied at the recommended rates increased yield over that with the 28% UAN alone.
- The addition of NutriSphere-N increased yield over 2 bu/A.
- Over 8 bu/A yield increase was seen with the addition of eNhance to 28%, plus 14 less gallons per acre were applied per acre.
- Highest yield was achieved with 56 gal/A of 28% with the experimental product HN-07. An increase in over 12 bu/A was seen with 14 less gallons applied per acre.
- This is a great starting point for comparing different nitrogen additives for sidedressed corn. This work will be expanded into a replicated trial next season.

**Experiment:** Nitrogen Rate & Source Comparison for Corn on Corn

**Year (Experiment Number):** 2008 (08-311)

**Date of Planting/Harvest:** April 29 / October 22

**Variety:** DeKalb 5259

**Plot Size (replications):** 15 ft x 210/130 ft (5 replications)

**Soil Test Levels (ppm)**

pH: 7.5 C.E.C.: 8.3

OM: 1.6% Bicarb P: 14 ppm

K: 70 ppm (2.2% BS)

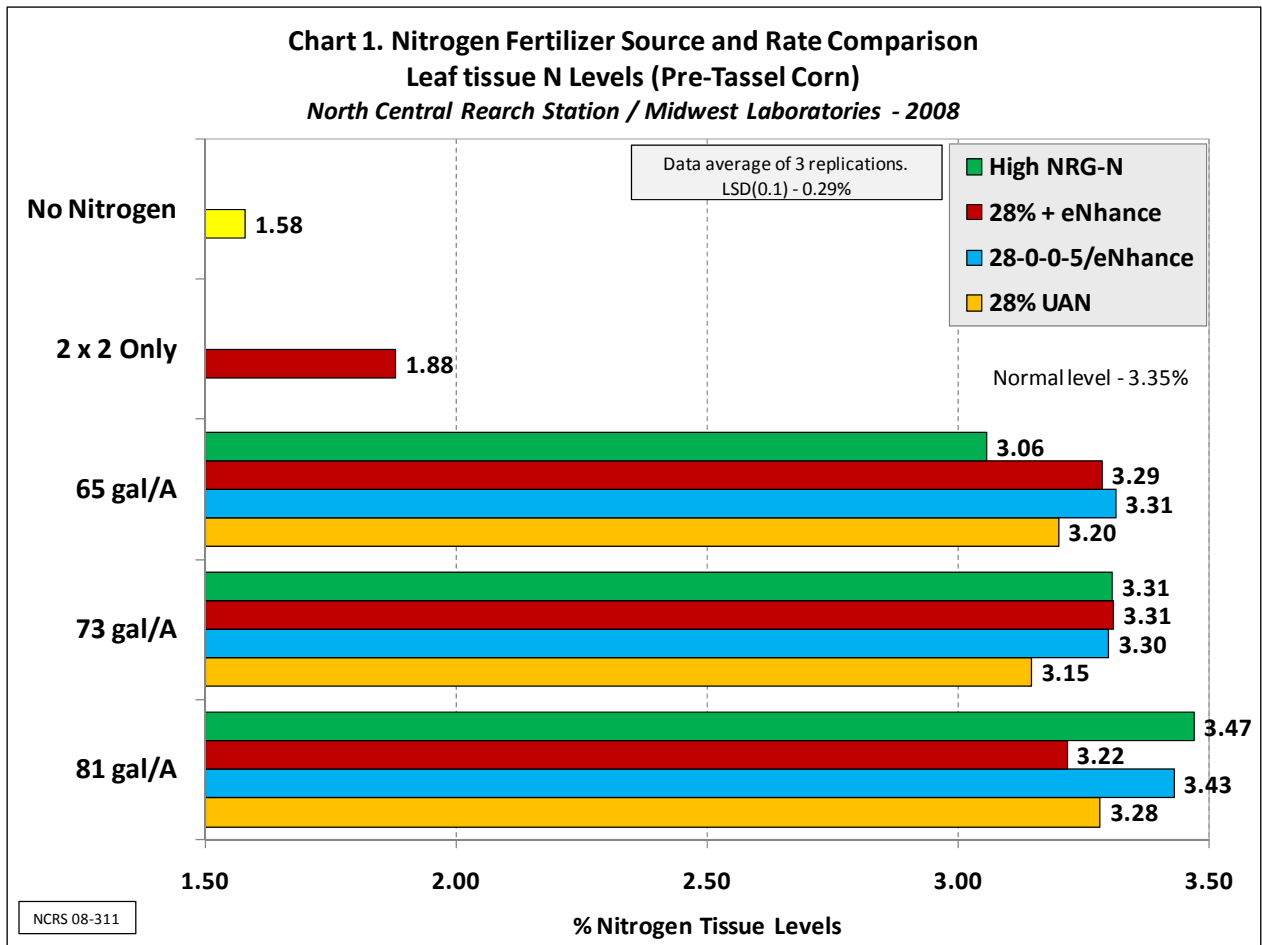
**Objective:** Compare yield response of corn following corn from different rates and sources of nitrogen.

With increased acres of planted corn in response to anticipated higher seasonal grain price in the 2008 season, there was more corn planted on ground that was in corn the previous year. Thus, the corn will not have the benefit of carry-over nitrogen from in rotation following soybeans which has been the norm in most years in the Midwest. Typically at the NCRS, 210 lb/A of nitrogen is applied for a 200 Bu/A yield goal when corn follows soybeans, and the resulting yields are usually at least 30 bu/A more than the 200 Bu/A yield goal. This is according to the production guidelines in the *Tri-State Fertilizer Recommendations* from Michigan State University, Purdue University and (the) Ohio State University. For corn following corn (or wheat), the recommendation is for 245 lb of N per acre. In this experiment, corn was planted in a field which had been in corn that averaged in the 200 Bu/A range in 2007. Four different nitrogen sources were applied each at three different rates:

1. N Sources: 28% UAN, 28% UAN + *eNhance*, 28-0-0-5 + *eNhance* and High NRG-N. (28-0-0-5 is a blend of 32% UAN and ammonium thiosulfate.)
2. Rates of application: 65, 73 and 81 gal/A for 195, 219, and 243 lb-N/A. With the 81 gal/A rate being the 100% rate, the other rates would be 80 and 90% of the total. (Note: High NRG-N with 27% N has slightly less N per gallon compared to the other products, 2.88 vs 3 lb/gallon for 187-, 210-, and 233 lb-N/A with the three rates of application).

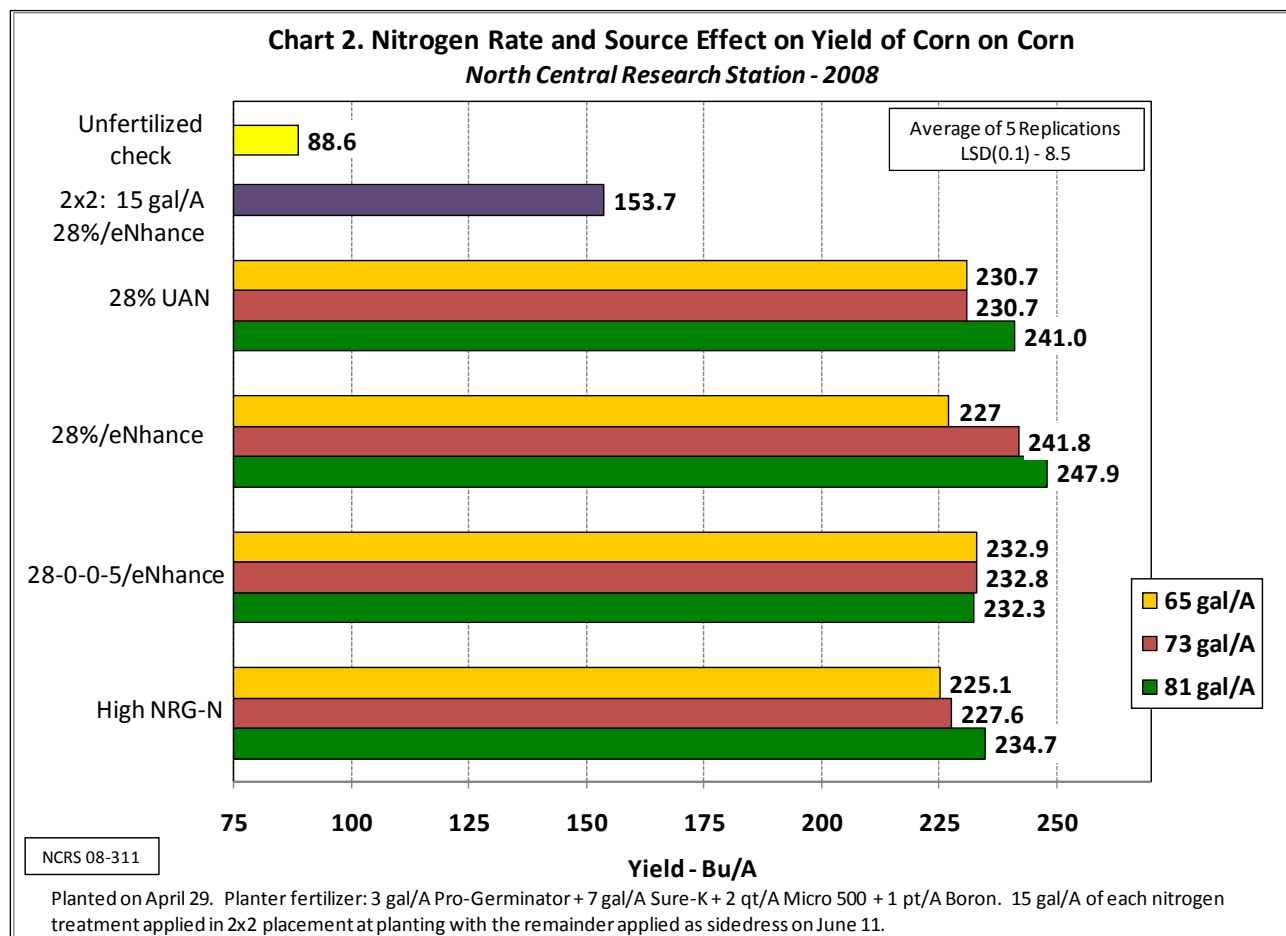
For the three rates of nitrogen, 15 gal/A was applied at planting in 2x2 placement on April 29, and the remainder was applied at sidedress 45 days after planting on June 11. Additionally, there was a no fertilizer check treatment as well as a treatment with 28%/eNhance applied 2x2 at planting with no sidedress. In-furrow planter fertilizer for all treatments (except the check) was 3 gal/A Pro-Germinator + 7 gal/A Sure-K + 2 qt/A Micro 500 + 1 pt/A Boron. Each treatment was replicated five times. This experiment was established under irrigation and conventional tillage with fall disk-chiseling of the 2007 stalks.

Corn leaf samples were collected at the pre-tassel growth stage and analyzed for leaf tissue nitrogen levels. Treatment results appear in Chart 1.



- Nitrogen leaf tissue levels increased significantly as applied nitrogen rate increased from 0 to 15 to 65 gal/A, but there was generally no further significant differences between rates and sources.
- Leaf tissue N levels were near normal levels at rates of 65 gal/A or higher.

Treatment yields appear in Chart 2.



- While there was a significant rate response from the check to 15 gal/A, and from 15 gal/A to 65 gal/A, there generally was no further rate response with these rates applied.
- Highest yield was obtained with the full 81 gal/A rate of 28%/eNhance.
- The addition of eNhance did result in a significant yield increase at the 73 gal/A application rate compared to that rate of 28% without eNhance. (241.8 Bu/A vs. 230.7 Bu/A). The yield obtained with this 90% application rate with eNhance was comparable to the 100% rate of 28% without eNhance.
- The general lack of strong yield response between the 65 gal/A rate and the 81 gal/A rate, a spread of 16 gal/A or 48 lb of N/A, was surprising considering this was second year corn. Oddly, the averages for the three rates of 28-0-0-5/eNhance differed by less than a bushel over five replications.
- This experiment followed university recommendations that said to apply 245 lb of N/A for a yield goal of 200 Bu/A, a yield that was substantially exceeded. We have conducted experiments in the past that used the pre-sidedress (soil) nitrate test (PSNT) as a guide for nitrogen applications, but found this to under-recommend nitrogen applications for high-yielding corn. Perhaps a combination of PSNT and earlier tissue tests could serve as a better guide in these times of high-priced crop inputs. Further research is needed and will be conducted at the NCRS.

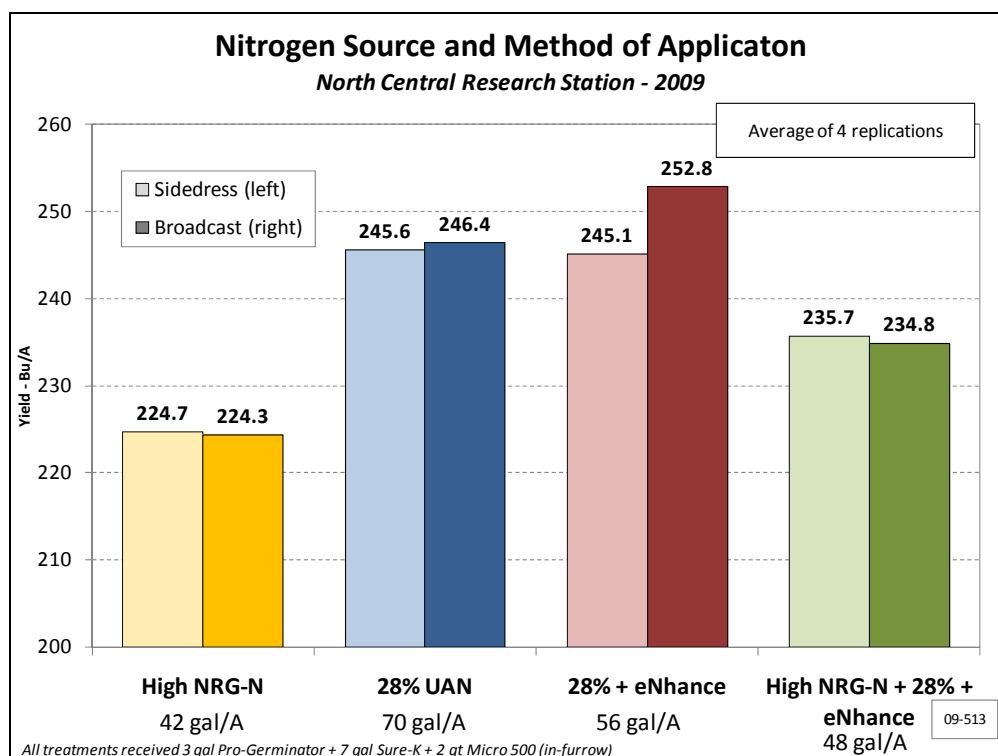


## Experiment: Nitrogen Source and Method of Application Comparison (09-513)

|                              |                            |                           |
|------------------------------|----------------------------|---------------------------|
| <b>Planted:</b> 5/8/09       | <b>Hybrid:</b> DKC52-59    | <b>Population:</b> 36,000 |
| <b>Plot Size:</b> 15' x 100' | <b>Replications:</b> 4     | <b>Harvested:</b> 11/5/09 |
| <b>Broadcast N:</b> 5/8/09   | <b>Sidedress N:</b> 6/4/09 |                           |

| Soil Test Values (ppm): |     |      |    |    |    |     |      |      |     |      |     |    |     |
|-------------------------|-----|------|----|----|----|-----|------|------|-----|------|-----|----|-----|
| pH                      | CEC | % OM | P1 | K  | S  | % K | % Mg | % Ca | % H | % Na | Zn  | Mn | B   |
| 6.8                     | 9.6 | 2.5  | 52 | 64 | 12 | 1.7 | 21.9 | 75.0 | 0   | 1.5  | 1.2 | 2  | 0.6 |

**Objectives:** There are many options when it comes to nitrogen sources along with how to apply it. In the past the NCRS has shown it did not matter which method of application was used when applying nitrogen, as long it was applied in time for the corn to use it. Here four nitrogen sources were evaluated: High NRG-N, 28% UAN, 28% UAN + eNhance, and a 50/50 blend by volume of High NRG-N and 28% + eNhance. Each nitrogen source was applied either broadcast after planting or sidedressed 27 days after planting.



Yield response per pound of nitrogen applied

| Yield | Lbs N applied | Bu/lb N applied |
|-------|---------------|-----------------|
| 224.7 | 121.3         | 1.85            |
| 224.3 | 121.3         | 1.85            |
| 245.6 | 207.8         | 1.18            |
| 246.4 | 207.8         | 1.19            |
| 245.1 | 166.2         | 1.47            |
| 252.8 | 166.2         | 1.52            |
| 235.7 | 140.6         | 1.68            |
| 234.8 | 140.6         | 1.67            |

LSD(0.05):15.8, CV: 5.7%

### Conclusions:

- Within each nitrogen source, both methods of applications produced similar yields. This is consistent with previously reported data.
- There was no statistical difference between nitrogen sources with the exception of High NRG-N. It has been found that in cool years such as this, there is little nitrogen loss, thus increasing the efficiency of UAN solutions. Because more actual nitrogen is applied, higher yields are achieved.
- The addition of eNhance to 28% UAN enabled comparable yield to the straight 28%, but with 14 fewer gallons per acre.

\*See *Product Descriptions* in the introduction for more information on ACLF products used.

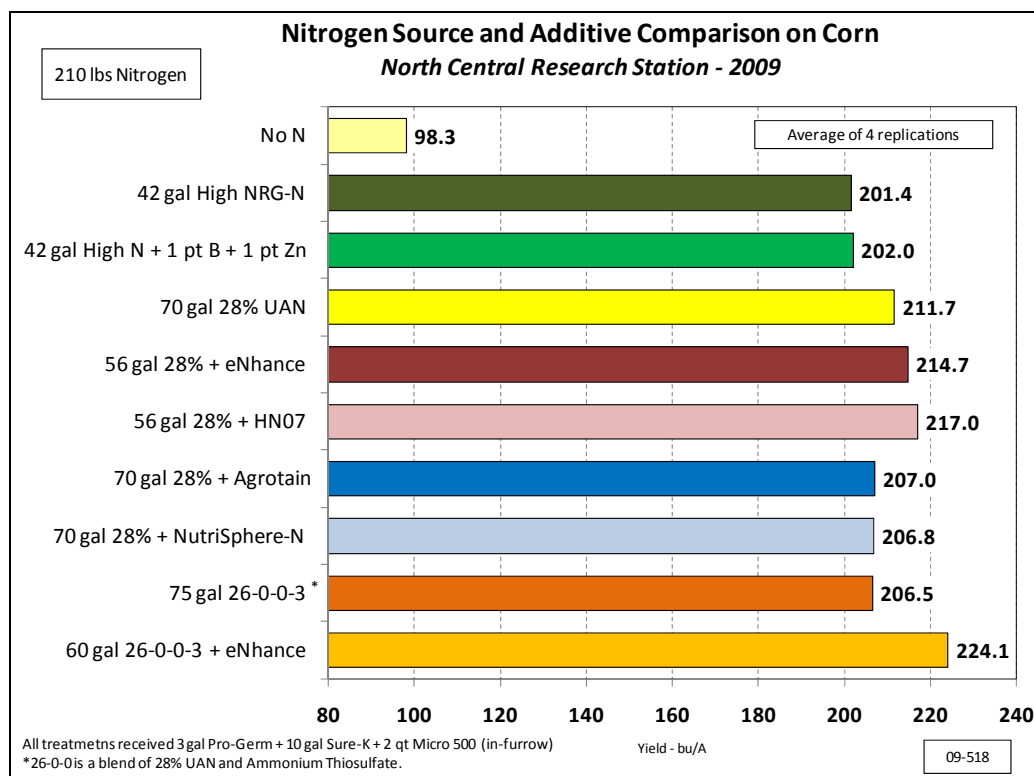


## Experiment: Nitrogen Source and Additive Comparison on Corn (09-518)

|                       |                  |                    |
|-----------------------|------------------|--------------------|
| Planted: 5/5/09       | Hybrid: DKC46-60 | Population: 36,000 |
| Plot Size: 15' x 130' | Replications: 4  | Harvested: 11/4/09 |
| Sidedress: 6/5/09     |                  |                    |

| Soil Test Values (ppm): |     |      |        |    |   |     |      |      |     |      |     |    |     |
|-------------------------|-----|------|--------|----|---|-----|------|------|-----|------|-----|----|-----|
| pH                      | CEC | % OM | Bicarb | K  | S | % K | % Mg | % Ca | % H | % Na | Zn  | Mn | B   |
| 7.2                     | 7.8 | 1.5  | 12     | 53 | 7 | 1.7 | 25.4 | 71.7 | 0   | 1.2  | 0.9 | 5  | 0.5 |

**Objectives:** There are many options for nitrogen sources on the market today, and more options for nitrogen additives are becoming available to reduce loss and increase efficiency of UAN solutions. This experiment compares numerous nitrogen options for corn including Agro-Culture Liquid Fertilizers' eNhance and experiment HN07 (a 20% sulfur combined at 20 gal per ton of 28%).



Yield response per pound of nitrogen applied

| Yield | Lbs N applied | Bu/lb N applied |
|-------|---------------|-----------------|
| 201.4 | 121.3         | 1.66            |
| 202.0 | 121.3         | 1.67            |
| 211.7 | 207.8         | 1.02            |
| 214.7 | 166.2         | 1.29            |
| 217.0 | 166.2         | 1.35            |
| 207.0 | 207.8         | 1.00            |
| 206.8 | 207.8         | 1.00            |
| 206.5 | 209.6         | 0.99            |
| 224.1 | 167.7         | 1.33            |

LSD (0.1): 15.9, CV: 17.5%

### Conclusions:

- All nitrogen sources and additives increased corn yield over the no nitrogen check.
- The addition of *eNhance* and the experimental product *HN07* to conventional UAN solutions produces better yields while applying 20% less nitrogen per acre.
- The addition of Agrotain® and NutriSphere-N® did not produce higher yields than the 28% UAN alone.
- The addition of micronutrients to High NRG-N did not increase yield. This may be due to the 2 qt of Micro 500 were applied at planting.
- Highest yield returned per pound of nitrogen applied was with High NRG-N, followed by UAN that reduced rates with the additives *eNhance* and *HN07*.

\*See *Product Descriptions* in the introduction for more information on ACLF products used.



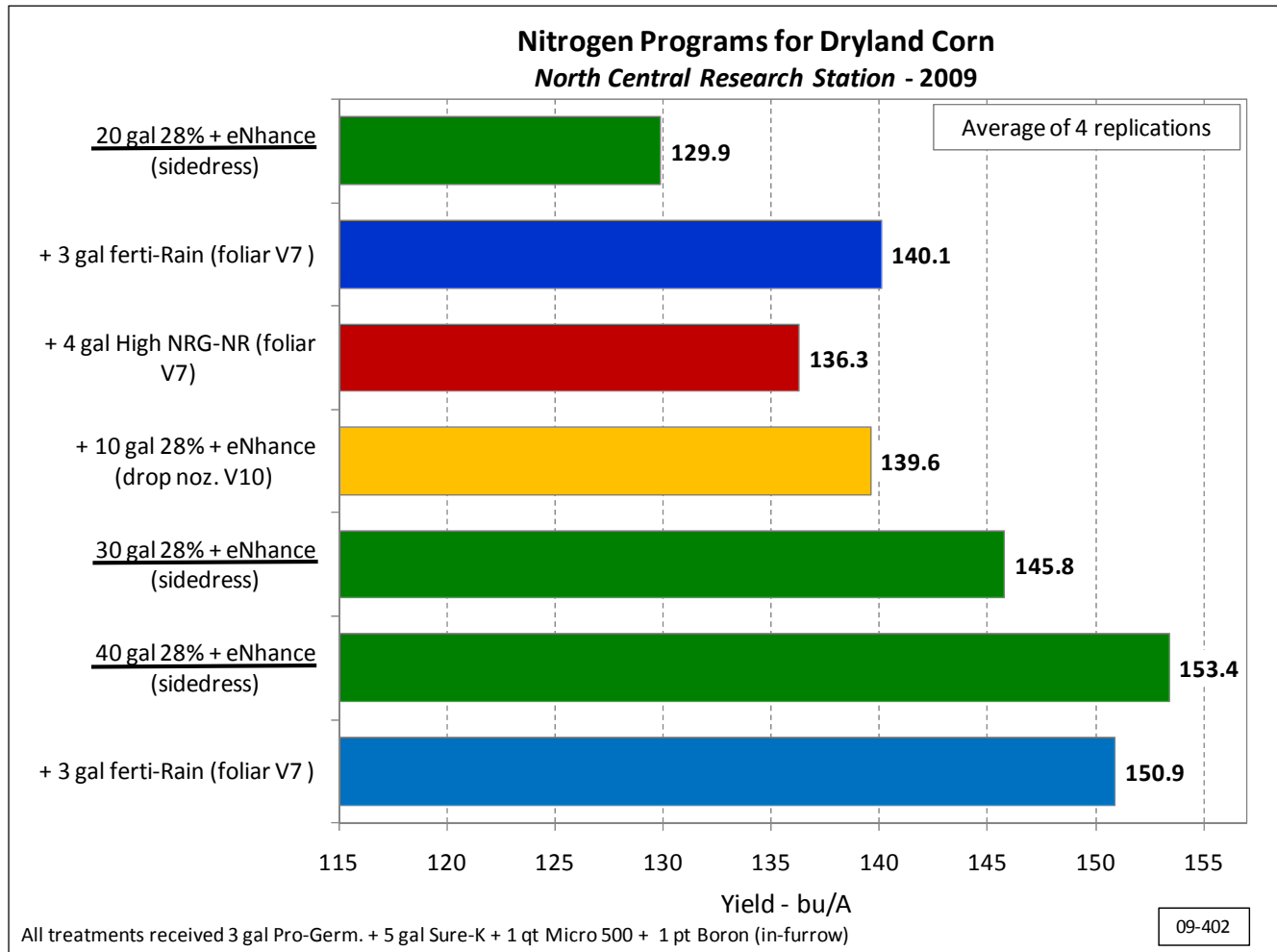
**Experiment: Nitrogen Programs on Dryland Corn (09-402)**

|                              |                             |                             |
|------------------------------|-----------------------------|-----------------------------|
| <b>Planted:</b> 5/5/09       | <b>Hybrid:</b> DKC46-60     | <b>Population:</b> 28,000   |
| <b>Plot Size:</b> 15' x 100' | <b>Replications:</b> 4      | <b>Harvested:</b> 11/3/09   |
| <b>Sidedress:</b> 6/4/09     | <b>Foliar (V7):</b> 6/22/09 | <b>Drop Nozzles:</b> 7/8/09 |
|                              | <b>Foliar (V9):</b> 7/1/09  |                             |

| Soil Test Values (ppm): |     |      |    |    |    |     |      |      |     |      |     |    |     |
|-------------------------|-----|------|----|----|----|-----|------|------|-----|------|-----|----|-----|
| pH                      | CEC | % OM | P1 | K  | S  | % K | % Mg | % Ca | % H | % Na | Zn  | Mn | B   |
| 6.3                     | 6.1 | 0.9  | 52 | 83 | 11 | 3.5 | 14.1 | 72.1 | 9.6 | 0.7  | 0.6 | 5  | 0.4 |

**Objectives:** 1. Determine effects of different rates of sidedressed nitrogen on corn yield, 2. What are some “rescue” options for yellow (nitrogen deficient) corn?

**Results:**



LSD(0.2): 9.7. CV: 13.2%

**Conclusions:**

- Corn yield increased with increased rate of sidedressed 28% + eNhance.
- The 20 gal/A sidedress rate of 28%+eNhance did result in a nitrogen deficiency, a situation sometimes seen in fields even when full rates of N is applied, but losses occur due to environmental influences (rain, volatility). But foliar applications of ferti-Rain and High NRG-NR did result in a yield increase. But the

\*See Product Descriptions in the introduction for more information on ACLF products used.

increase was not up to that obtained by higher rates of sidedressed nitrogen in the first place. But it does show “rescue” options.

- Another “rescue” option is a late drop nozzle application of more nitrogen, as in the case of 10 gal/A of 28% + enhance. This gave a yield increase similar to that of the foliar applications. This was a total application of 30 gal/A (20 gal/A sidedressed and 10 gal/A drop nozzle), and was lower in yield than the 30 gal/A applied all at once at sidedress. This illustrates the importance of proper timing of applications.

**Experiment:** Urea and 28% + eNhanche comparison in irrigated corn (09-503)

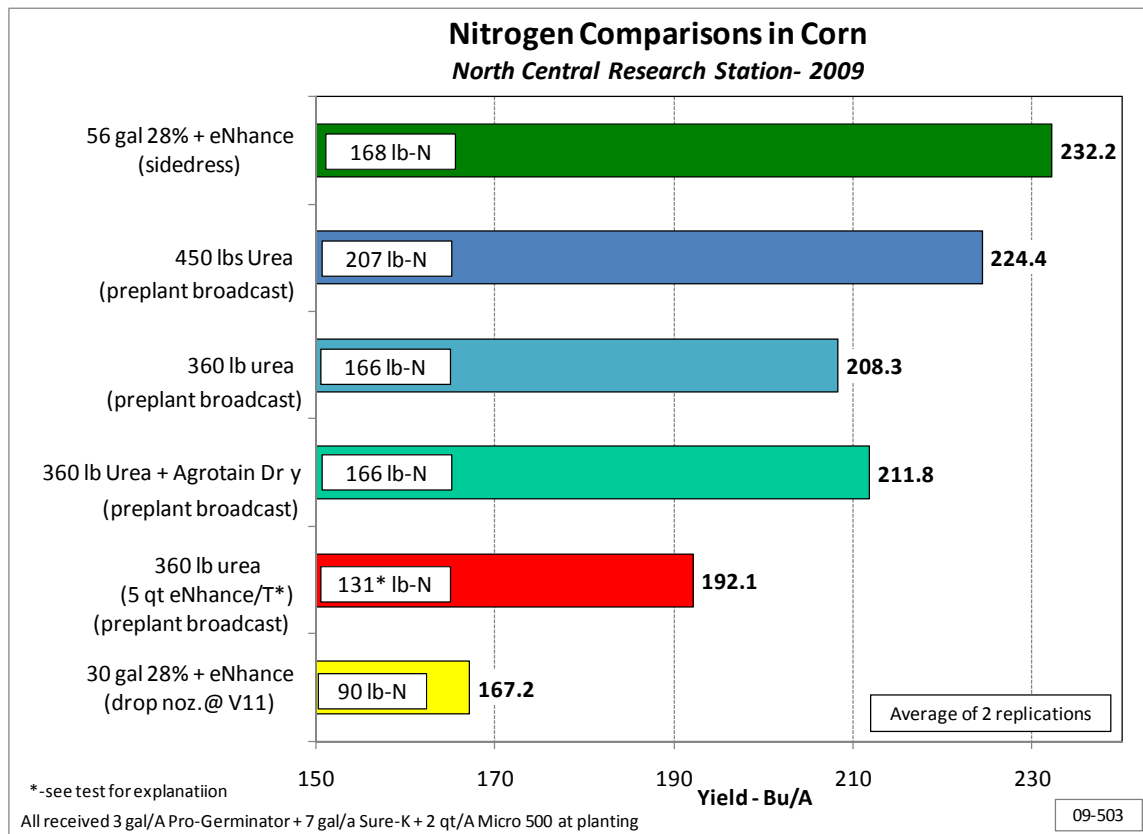
|                                   |                          |                           |
|-----------------------------------|--------------------------|---------------------------|
| <b>Planted:</b> 5/6/09            | <b>Hybrid:</b> DKC4660   | <b>Population:</b> 36,000 |
| <b>Plot Size:</b> 15' x 290'/300' | <b>Replications:</b> 2   | <b>Harvested:</b> 11/3/09 |
| <b>Urea:</b> 5/5/09               | <b>Sidedress:</b> 6/3/09 |                           |

| <b>Soil Test Values (ppm):</b> |     |      |        |    |   |     |      |      |     |      |     |    |     |
|--------------------------------|-----|------|--------|----|---|-----|------|------|-----|------|-----|----|-----|
| pH                             | CEC | % OM | Bicarb | K  | S | % K | % Mg | % Ca | % H | % Na | Zn  | Mn | B   |
| 7.1                            | 7.5 | 1.6  | 21     | 72 | 7 | 2.5 | 25.4 | 70.9 | 0   | 1.2  | 1.1 | 5  | 0.5 |

**Objectives:** 1. Compare applications of urea at a full rate (207 lb-N/A) and a reduced rate (80% or 166 lb-N/A to a reduced rate (168 lb-N/A) of 28% UAN + eNhanche for corn yield; 2. Compare reduced rate of urea plus either Agritain Dry and eNhanche for effects on corn yield.

**Application information:** The urea was broadcast applied with a specially- built air applicator for plots, as seen in the accompanying picture. The urea was worked into the ground with a field cultivator the day after application. One treatment had a reduced rate of 28% + eNhanche applied through drop nozzles for evaluation as a “rescue” treatment. This was on July 11 to corn that was 46” tall in the V11 stage. It was clearly nitrogen deficient at the time.

**Results:**



LSD(0.1): 13.5; (0.2): 10.0. CV: 11.2%



| <b>Responsible Nutrient Management : Bushels produced per lb-N applied</b> |          |          |          |                         |
|--|----------|----------|----------|-------------------------|
| 28%+eNhanche   | 56 gal/A | 232,2 bu | 168 lb-N | 1.4 bu per lb-N applied |
| urea   | 450 lb/A | 224.4 bu | 207 lb-N | 1.1 bu per lb-N applied |

\*See Product Descriptions in the introduction for more information on ACLF products used.

## Conclusions:

- The corn treated with the reduced rate of 28% + eNhance yielded higher than the full rate of broadcast urea.
- The corn treated with the reduced rate of 28% + eNhance (168 lb-N/A) yielded significantly higher than that treated with an equal rate of nitrogen from urea. This would indicate that the eNhance enables increased efficiency of nitrogen.
- The nitrogen stabilizer Agrotain Dry did not cause corn treated with a reduced rate of urea to yield higher than that of the untreated urea.
- eNhance did not prove to be an effective additive for urea, as is the case with nitrogen solutions. This is because the treated urea was too wet and did not flow evenly through the applicator. In fact, the urea “bridged” up in the “hopper”. By weighing the urea added to the machine and the amount left over after application, it was found that only 285 lb-urea/A was applied instead of the intended 360 lb/A (131 lb-N/A instead of 166 lb-N/A, or 78% of the intended rate.) In fact, this intended rate of eNhance impregnated on urea was lower than should have been applied, based on the solution application rate of 2 gallons per ton of 28% UAN. This is 2 gal/560 lb-N, or 0.46 fluid oz eNhance per pound of N. One ton of urea has 920 lb of N, and should require 3.3 gallons of eNhance to be equivalent. We knew that this rate of eNhance would be too much to blend with the urea, so the rate was reduced to a 5 qt per ton. But this too did not blend well, and so eNhance is not recommended for use with urea.
- The so-called “rescue” treatment of 30 gal/A of 28%+eNhance as a late application through drop nozzles produced a yield of 167.2 Bu/A. This was 72% of the top-yielding treatment of 56 gal/A at sidedress. This experiment did not have a no-nitrogen treatment. But typically we have found a no-nitrogen treatment to yield around half of the nitrogen-added treatments. So there was a positive response if you consider that doing nothing would have yielded around 110 Bu/A.



Drop-nozzle application to a plot which had received no earlier nitrogen. The plots are 6 rows wide, or 3 rows on each side of the orange stake. To the right is a plot that was sidedressed with 56 gal/A of 28%+eNhance and to the left is a plot that received 450 lb/A of urea. These are dark green. Notice the outside row of the drop nozzle plot has “captured” some nitrogen from the adjacent plot. This is why we do not harvest the outside “border” rows of the plots.