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Product Description

Weather Report

Irrigation Report

Field Crops

Introduction

Intern’s picture year in review

Report
**Pro-Germinator™** A high-quality, dual form phosphate fertilizer with multi-form nitrogen for immediate uptake and superior usability well into the growing season. (9-24-3-0.1Fe)

**Sure-K™** A versatile, chloride- and hydroxide-free potassium fertilizer for extremely efficient results in all cropping environments. (2-1-6)

**High NRG-N™** A multi-form nitrogen fertilizer with one percent sulfur for effective, season-long nitrogen availability for more efficient applications. (27-0-0-1S)

**Micro 500™** A proprietary formulation of zinc, manganese, iron, copper and boron to maximize micro-nutrient efficiency. (1.8%Zn, 1.2%Mn, 0.37%Fe, 0.25%Cu, 0.02B) (Additionally, individual secondary and micronutrients are produced using proprietary chelation chemistry.)

**eNhance™** The only nitrogen supplement formulated to work within the plant to produce greater nitrogen availability and reduce input costs. (Note: eNhance is added to UAN solutions at a rate of 2 gallons per ton of 28% and 2.25 gallons per ton of 32%). (8.7% S, 0.07% zinc, 0.07% manganese)

**LiberateCa™** For precision placement of usable calcium and improved availability in conservation tillage environments. (3% Ca)

**ferti-Rain™** Combines proprietary new technology and proven chemistry to simulate rapid nutrient uptake and plant development through foliar application. (12-3-3-1.5S-0.1Fe-0.05Mn-0.1Zn) (ferti-Rain™ was formerly known as F-07 during development.)

**NResponse™** Stabilized liquid urea-based nitrogen plus sulfur. (20% urea, 2% ammoniacal, 2% nitrate nitrogen,1% sulfur). Used primarily as a foliar application.

**accesS™** It is a Sulfur fertilizer supplemented with micronutrients, with an analysis of 17% sulfur and 0.25% each of iron and manganese. It is used in two ways: added to UAN solutions (20 gal per ton of 28%) or as a sulfur additive to planter (NOT in the seed furrow) and sidedress applications where additional sulfur is needed.

**S-Calate™** This is the newest crop nutrition product introduced in late 2012, with an analysis of 14% sulfur, 7% nitrogen and 1% calcium. Like accesS™, it is used in two ways: added to UAN solutions (20 gal per ton of 28%) or as a sulfur additive to planter (NOT in the seed furrow) and sidedress applications where additional sulfur is needed. It is being targeted for soils with low pH.
This year was like no other, higher than normal rainfall in April made it difficult to get planting started. Typically we begin sometime in mid to late April, however this year our first day in the fields was May 1st. With great dedication of the entire staff we were able to play catch up pretty quick and got all the corn planted in two weeks. It was a good thing too, as it began to rain again with more above normal amounts falling. However, we made up for it in the summer as once it hit July we had below normal rainfall. This coupled with extremely hot weather greatly influenced yields in our rain-fed farms.

### 2013 Weather Summary
**North Central Research Station**

<table>
<thead>
<tr>
<th>Month</th>
<th>High Temp.</th>
<th>Date</th>
<th>Low Temp.</th>
<th>Date</th>
<th>Avg. Temp</th>
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<td>30</td>
<td>20.6</td>
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<tr>
<td>May</td>
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<td>23</td>
<td>41.2</td>
<td>3</td>
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<tr>
<td>July</td>
<td>98.3</td>
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<td>47.3</td>
<td>25</td>
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<tr>
<td>August</td>
<td>89.7</td>
<td>25</td>
<td>44.6</td>
<td>15</td>
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<tr>
<td>September</td>
<td>94.1</td>
<td>10</td>
<td>33.1</td>
<td>17</td>
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<td>October</td>
<td>83.2</td>
<td>3</td>
<td>28.4</td>
<td>27</td>
<td>51.4</td>
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<table>
<thead>
<tr>
<th>Month</th>
<th>GGD</th>
<th>NCRS Avg GGD</th>
<th>Rainfall</th>
<th>NCRS Avg Rainfall</th>
<th>Rain Days</th>
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<td>122.8</td>
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<tr>
<td>May</td>
<td>426.6</td>
<td>316.8</td>
<td>4.26</td>
<td>4.2</td>
<td>8</td>
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<tr>
<td>June</td>
<td>541.4</td>
<td>542.4</td>
<td>3.45</td>
<td>2.0</td>
<td>12</td>
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<td>July</td>
<td>683.9</td>
<td>672.4</td>
<td>1.51</td>
<td>3.6</td>
<td>10</td>
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<tr>
<td>August</td>
<td>548.8</td>
<td>595.9</td>
<td>1.44</td>
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<tr>
<td>September</td>
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<td>377.2</td>
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<td>October</td>
<td>178.0</td>
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<td>16</td>
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<tr>
<td>Total</td>
<td>2840.5</td>
<td>2727.2</td>
<td>25.0</td>
<td>23.0</td>
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</tr>
<tr>
<td>Total (thru Sept.)</td>
<td>2662.5</td>
<td>2601.9</td>
<td>21.5</td>
<td>20.3</td>
<td>82</td>
</tr>
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</table>
We were glad to have irrigation this year. An extremely wet spring caused crops not to root down as deep as they normally would have. This followed by a very dry summer was not a good combination. Irrigation began running on June 21st and did not turn off until September. Yields were good on irrigated ground, however those that relied on mother nature for moisture did not perform as well.

Each week we aim for at least one inch of water either from natural rainfall occurrences or from supplemental irrigation. This year we had our intern Chance, monitor the irrigation systems overnight. See his poster for a picture of his view late at night while checking the systems.

### 2013 Irrigation Report
North Central Research Station

<table>
<thead>
<tr>
<th>Farm 3</th>
<th>Farm 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/21</td>
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<tr>
<td>6/28</td>
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<tr>
<td>7/3</td>
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<td>7/12</td>
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<tr>
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<tr>
<td>8/9</td>
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<tr>
<td>8/16</td>
<td>8/16</td>
</tr>
<tr>
<td>8/23</td>
<td>8/23</td>
</tr>
<tr>
<td>9/6</td>
<td>9/6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>9.3 in</td>
<td>8.8 in</td>
</tr>
</tbody>
</table>
Another season has come and gone at the North Central Research Station and as expected, 2013 turned out to be different than years past.

In the fall of 2012 we added a new 50-acre farm, bringing our total up to 12 Farms and 580 tillable acres. This farm is dedicated to demonstration plots, which were used at the Research Field Days and for sales staff training. With higher organic matter and lower nutrient levels, this soil provided many opportunities for diagnosing nutrient deficiencies. Because this farm was used completely for demonstrations, no harvest data was collected. There are big plans underway for the 2014 Research Field Days, so expect to visit this farm again.

A new farm means more work, so to help with the additional workload we hired a familiar face. Jeff Brown, past summer intern, started full time in January to help with the NCRS field crop operations. With his knowledge of the daily operations of the NCRS, he fit right into the operations quickly.

Preparation for the 2013 season began in March with the development of the experiment protocols. To help us be more organized and to have better access to our research data, Tim Duckert developed a database to store all of our field information in. After many hours of development work and trained on usage, the NCRS database was up and running just in time to enter the treatment list. This relational database contains many resources including plot plans, application information, environmental condition records, soil test reports, fertilizer recommendations, scouting reports and harvest data. This information is all stored on a secure network to insure data is not lost and can be accessed by us anywhere by use of cell phones and iPads. This has greatly improved the accuracy of record keeping and increased overall productivity.

Now that plans are all set it was time to go to the field. However, a heavy 9 inch rain period in late April delayed planting until May 1st. For many growers May 1st corn planting seems late, however this is very typical of Mid-Michigan; we have just been spoiled the last few years being able to get into the fields in April. A two week stretch of good weather allowed for all the corn and many soybean plots to be planted in May. Another short rain delay occurred but we were able to finish planting by early June.

Sidedress applications followed, another new addition this year was the Hagie nitrogen toolbar. This unit attaches to the Hagie sprayer and coulter injects nitrogen down the center of the corn rows. Having this attachment allowed us to use the 6 large stainless steel tanks and 4 injector tanks to speed up the sidedress process.

Helping out this summer we had two college interns. Chance Reynolds, a junior from West Texas A&M, arrived mid-summer and helped us with research projects, monitoring irrigation and working on his own nitrogen project. Our second student was Mike Schultz; a sophomore from Michigan State University began shortly after planting and worked through the Research Field Days. He spoke at all 6 of the field day events about a nitrogen research project he and Chance worked on.

Foliar applications and field days took up most of the summer days and before we knew it, it was time to say good-bye to the interns and get ready for harvest. Weather was good and harvest ran smoothly. With the help of the database to organize harvest numbers, results were summarized quickly and compiled into this, the 2013 Field Crop Research Report.

Stephanie Zelinko, Field Agronomy Research Manager
Tim Duckert, Field Agronomy Research Manager
Here we are calibrating the AgXcel Fertilizer units to ensure accuracy on the amount of fertilizer we are applying.

I am applying dry fertilizer with the air spreader. We are doing this to compare our competitors fertilizer against our own.

Here, I’m taking wheat samples for moisture and test weight.

Here, I’m operating the tractor with the grain cart attached. We use the grain cart to measure the actual weight of the crop for each plot.

I am packing the soil that the alfalfa was planted in so that stones are pushed down and also to break up lumps of soil to ensure uniform germination.

Here, I am putting liquid fertilizer into the application tank on the strip-till machine.
2013 North Central Research Station Field Crop Internship Chance Reynolds

Taking Stand Counts to calculate established stand
Collecting Wheat Test Plot samples for weighing
Driving the Grain Cart during harvest

Learning to operate the Hagie and about GPS navigation
Attending Ag Expo 2013 at Michigan State

Checking Linears at night. Making sure Farm 3 and 5 get right amount of irrigation
Cleaning up alleyways with the Rototiller
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Navy Bean Foliar Timing Comparison (13-308)
**Objective:**

To evaluate an experimental nitrogen product for yield response on corn.

Agro-Culture Liquid Fertilizers is continuously working on improving their products, to provide better resources for growers. In 2013, an experimental nitrogen product, NF-13 was added to the testing protocols. This product is a nitrogen solution with sulfur and has a recommended application at 80% of the conventional nitrogen rate. In order to pass the rounds of testing to become a new product, experimental products like NF-13 have to provide a significant benefit over the existing product. It also has to have proven performance at the NCRS along with contract research sites and on-farm testing. In the first year of testing, the experimental product NF-13 at 56 gal/A was compared to the recommended rates of High NRG-N, 28% + eNhance and 28%. Applications were made at sidedress, 37 days after planting to V4 corn. Yield results appear on the chart below.

**Conclusions:**

- At this location, NF-13 did not yield as high as High NRG-N. Continued evaluation of yield results on this product will need to be done to determine if more testing should be done.
- Highest yield was achieved with 28% + eNhance with a yield of 200.7 bu/A. This yielded similar to a higher rate of 28%.
Objective:
To compare different nitrogen sources and methods of application for effects on corn yield.

There are many ways to apply nitrogen on a corn crop. This experiment compared a broadcast application applied after planting and before emergence, a mid-row sidedress application coulter injected 30 days after planting and a split application where 20 gal/A were applied 2x2 at planting with the remaining gallons applied sidedress. Two products, High NRG-N and 28% + eNhance were compared at each method of application. A final treatment looked at the split application using High NRG-N 2x2 at planting, followed by 28% + eNhance at sidedress. Broadcast applications were made 4 days after planting on May 9th. Sidedress applications were made 34 days after planting on June 12th. An application of 220 lbs of equivalent nitrogen per acre was applied for a yield goal of 200 bu/A of irrigated corn. Yield results appear on the chart below.

Conclusions:
• Of the three methods of application for the two products, sidedress produced the highest yield.
• For the second year of this experiment, highest yield was achieved with the split application that applied High NRG-N 2x2 at planting followed by 28% + eNhance at sidedress.
• In years of high rainfall, there is a risk of nitrogen loss with early broadcast applications. Likewise, sidedress applications are risky as it is critical to have nitrogen available by 30-40 days after planting or deficiencies could occur.
• To even risks, a split application provides some early nitrogen without risk of losing too much if a rain event occurs and give additional time to make sidedress applications.

Soil Test Values (ppm):
- pH: 7.2
- CEC: 8.3
- % OM: 1.9
- Bicarb P: 25
- K: 67
- S: 8
- % K: 2.1
- % Mg: 23.3
- % Ca: 73.3
- % H: 0
- % Na: 1.3
- Zn: 2
- Mn: 12
- B: 0.6

Experiment Info:
- Planted: 5/9
- Variety: P0216HR
- Population: 38,500
- Row Spacing: 30"
- Previous Crop: Soybeans
- Plot Size: 15’x270/310’
- Replications: 4
- PRE: 5/13
- Sidedress: 6/12
- Harvested: 10/15

Yield Goal: 200 bu
Target Fertilizer Rate: 210-0-105

Corn Nitrogen Method of Application Comparison
North Central Research Station - 2013

Average of 4 Replications

Planted: May 9th
Broadcast: May 13th
Sidedress: June 12th

**Split Applications:** 20 gal 2x2 and remaining sidedressed.
HN= High NRG-N

<table>
<thead>
<tr>
<th>Nitrogen Source and Method of Application</th>
<th>Yield - bu/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast 51 gal High NRG-N</td>
<td>207.0</td>
</tr>
<tr>
<td>2 x 2* / Sidedress 20 gal 2x2 36 gal 28% + eNhance</td>
<td>213.0</td>
</tr>
<tr>
<td>Sidess 20 gal 28% + eNhance</td>
<td>220.4</td>
</tr>
<tr>
<td>Broadcast 59 gal 28% + eNhance</td>
<td>215.9</td>
</tr>
<tr>
<td>2 x 2* / Sidedress 59 gal 28% + eNhance</td>
<td>217.9</td>
</tr>
<tr>
<td>Sidedress</td>
<td>218.8</td>
</tr>
</tbody>
</table>

LSD (0.1): 9.3  CV: 4.4%
**Objective:**

To compare nutrient programs when used in combination with and without manure applications.

The North Central Research Station has applied dairy manure to areas of this particular field for 16 straight years. The crop for the previous 15 years has been continuous corn. The experiment is divided into 4 sections, 2 sections have no manure applied, 1 section receives a 20 ton/A application in the fall and the fourth section receives an application in the fall and spring for a 40 ton/A total. Fall applications are chisel plowed into the soil, while spring applications are applied to spring tilled soil and then tilled with a soil finisher for soil incorporation. Soil samples were taken again last fall to continually observe the changes in soil tests. All treatment rates follow soil test recommendations with the exception of phosphorus. According to soil test recommendations additional phosphorus fertilizer is not recommended in any of the sections. However, in corn, past research has proven that available phosphorus close to the seed at planting time in the cooler soils will give a stronger plant, increased growth and limit phosphorus deficiency symptoms. Therefore, the standard recommendation of 3 gal/A of Pro-Germinator (PG) was used in the planter fertilizer. The remaining nutrients include 2 qt/A of Micro 500 + 10 gal/A of High NRG-N (HN) all applied 2x2. The no manure section also received 10 gal/A of Sure-K (SK) in the planter fertilizer to meet the recommendation.

**Conclusions:**

- Significantly higher yields were achieved with the use of manure. Fall and spring applications resulted in a 40+ bu/A increase over the no manure treatments.

- Organic matter, Phosphorus and Potassium levels all increase with the use of manure.

- Maintain accurate soil tests and follow recommendations for supplemental nutrient application. Most likely potassium usage can be reduced.

- Micro nutrients and some Phosphorus are still needed for corn.
Objective:
To determine the optimum time for fertilizing a corn crop with potassium.

Agro-Culture Liquid Fertilizer’s Sure-K is seed safe to allow application of the required nutrients in-furrow when planting. Sometimes the question of when to apply potassium, if not with the planter, comes up. In determining to answer that question, a broadcast rate of Sure-K was applied in the fall. A comparison of fall broadcasted Potash was also applied. Both treatments were incorporated into the soil by chisel plowing the previous corn crop residue. The spring broadcast treatment of Sure-K was made and incorporated with a soil finisher before planting. Yield results appear in the table below.

Conclusions:
- The 4 gal/A rate of Sure-K gave nearly identical yields as the higher rate of Sure-K broadcasted or the dry Potash applications. The in-furrow placement puts nutrients where they are needed.
- Planter applied, fall or spring broadcast of potassium had no significant yield advantage to each other. The difference comes in the amount of nutrients applied to realize similar yields.
- In spite of these results, broadcast applications are not recommended at this time until more research is conducted.
- The no planter fertilizer treatment lacked the necessary nutrients needed to accomplish its yield potential.
- If Sure-K is going to be broadcast applied, a 20% increase in rate is needed to achieve comparable yields to planter applied rates.

<table>
<thead>
<tr>
<th>Potassium Fertilizer Timing in Corn</th>
<th>North Central Research Station - 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield - bu/A</td>
<td>Average of 4 Replications</td>
</tr>
<tr>
<td>No Planter Fert.</td>
<td>136.9</td>
</tr>
<tr>
<td>5 gal Sure-K (Fall Broadcast)</td>
<td>149.3</td>
</tr>
<tr>
<td>5 gal Sure-K (Spring Broadcast)</td>
<td>151.0</td>
</tr>
<tr>
<td>4 gal Sure-K (In-Furrow)</td>
<td>149.0</td>
</tr>
<tr>
<td>87 lbs/A Potash (Fall Broadcast)</td>
<td>149.8</td>
</tr>
</tbody>
</table>

- All treatments included 7 gal Pro-Germ. + 2 qt Micro 500 at planting and were sidedressed with 52 gal High NRG-N.

LSD (0.): CV: %
**Objective:**
To evaluate the effectiveness of different nitrogen sources applied broadcast on corn.

This experiment compared pre emergence broadcast applications of different nitrogen solutions in a corn crop. Applications were made the day following planting. All sources were applied at the recommended rate to provide 192 lbs of equivalent nitrogen per acre for a yield goal on 175 bu/A. AgroLiquid products were High NRG-N, 28% + eNhance, 28% + accesS, a combination of High NRG-N and 28% + eNhance and an experimental product NF-13. These products were compared to conventional products 28% and ESN urea. Yields appear on the chart below.

**Conclusions:**
- All nitrogen solutions nearly reached the yield goal and greatly increased yield over the no nitrogen treatment.
- Highest yield was achieved with the full rate of 28% with the addition of eNhance, yielding 193 bu/A which was significantly higher than the same rate of 28% UAN without eNhance.
- The addition of 6 gal of access to 28% added 5 bu /A to the overall yield.
- Nitrogen sources that applied less actual nitrogen per acre, reached yield goal, but were not able to provide additional yield than the higher nitrogen rates.

**Nitrogen Source Comparison in Corn**
*North Central Research Station - 2013*

<table>
<thead>
<tr>
<th>Nitrogen Source</th>
<th>Yield - bu/A</th>
<th>Average of 4 Replications</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 gal High NRG-N</td>
<td>170.8</td>
<td></td>
</tr>
<tr>
<td>22.6 gal HN + 25.6 gal 28% + eN</td>
<td>171.3</td>
<td></td>
</tr>
<tr>
<td>51 gal NF-13</td>
<td>174.3</td>
<td></td>
</tr>
<tr>
<td>51 gal 28% + eNhance</td>
<td>179.4</td>
<td></td>
</tr>
<tr>
<td>64 gal 28% + eNhance</td>
<td>193.3</td>
<td></td>
</tr>
<tr>
<td>64 gal 28% + 6 gal access</td>
<td>190.3</td>
<td></td>
</tr>
<tr>
<td>64 gal 28%</td>
<td>185.1</td>
<td></td>
</tr>
<tr>
<td>426 lbs ESN</td>
<td>188.1</td>
<td></td>
</tr>
<tr>
<td>No Nitrogen</td>
<td>102.2</td>
<td></td>
</tr>
</tbody>
</table>

- All treatments received 5 gal Pro-Germ. + 5 gal Sure-K + 2 qt Micro 500 + 2 qt eNhance (IF). HN: High NRG-N eN: eNhance

**Soil Test Values (ppm):**
- pH: 6.5
- CEC: 14.2
- % OM: 2.5
- Bray P1: 14
- K: 109
- S: 11
- % K: 2.0
- % Mg: 18.5
- % Ca: 71.4
- % H: 7.6
- % Na: 0.5
- Zn: 1.0
- Mn: 4
- B: 0.4

**Yield Goal:** 175 bu
**Target Fertilizer Rate:** 192-70-70
**Objective:**

To compare planter applied fertilizer source effects on corn yield.

Each year more in-furrow fertilizer options are available, many of these are balanced products containing N, P, K and in some cases micronutrients. Carefully planned recommendations need to be conducted when comparing AgroLiquid products to these products. In order to make fair comparisons, use of the full AgroLiquid line should be utilized. This experiment compared four products: Trupointe, Season Pass (6-18-6), Nachurs G24 (6-24-6) and 3-20-15 to a combination of Pro-Germinator and Sure-K. All products were applied at 5 gal/A with in-furrow tubes. Due to the low soil test potassium levels, 7 gal/A Sure-K was applied sidedress with 45 gal/A High NRG-N to all treatments. Yield results appear on the chart below.

**Conclusions:**

- Better yield was obtained with the Pro-Germinator and Sure-K treatment, similar yield was achieved with all other in-furrow fertilizer products.
- One of AgroLiquid’s biggest advantages is the provision of a program to meet soil test needs and address almost every nutrient to help attain highest yield. Using a combination of Pro-Germinator and Sure-K can help, AgroLiquid Nutrition compare to these other inflexible products.
- Highest yield at 192 bu/A was reached with 2.5 gal/A Pro-Germinator and 2.5 gal/A Sure-K.
Objective:

To compare placement strategies in a corn spring strip-till program.

Strip tillage offers the ability to put nutrients in many different placements within the soil profile and yet very close to where the plant roots are going to make efficient use of them. This experiment compared a total AgroLiquid program of 4 gal/A of Pro-Germinator + 6 gal/A of Sure-K + 2 qt/A Micro 500 in different places of a spring tilled strip. An upper placement is the top 2” of the tilled strip and a lower placement is a narrow band 6-7” below the soil surface. The strips were tilled and nutrients applied with the NCRS Nutri-Till unit the same day as planting on May 8th. The AgroLiquid program was sometimes split by nutrient parts or by rates and applied in different placements. High NRG-N at the rate of 41 gal/A was used as the nitrogen source and always placed in the lower position of the strip. Continued testing of strip till nutrient placement will occur with a new Orthman 1tRiPr next year. Yields appear in the chart below.

Conclusions:

- The largest yield advantage resulted from having ¼ of the AgroLiquid program in the upper strip placement and the remainder in the lower position.
- A lower placement of P and K resulted in a larger yield than all P and K in the upper position.
- In-furrow placement, so that nutrients are close to the seed, provided an advantage over all of the nutrients placed in the upper strip.

Soil Test Values (ppm):

- pH: 6.6
- CEC: 21.5
- % OM: 5.1
- Bray P1: 16
- K: 108
- S: 12
- % K: 1.3
- % Mg: 17.5
- % Ca: 80.9
- % H: 0
- % Na: 0.3
- Zn: 1.1
- Mn: 2
- B: 0.8

Yield Goal: 175 bu
Target Fertilizer Rate: 195-60-110
Objective:

To compare the effects of placing a planter applied nitrogen source, High NRG-N, in-furrow on corn yield. In-furrow applications of High NRG-N can cause stand reductions and lower yields based on data from previous years of research at the North Central Research Station. This comparison was planted no-till into soybean stubble under ideal soil conditions and a soil temperature of 62 degrees Fahrenheit. Emergence occurred under favorable conditions. The soil test for this field has a 5.1% organic matter and a CEC of 21.5. In-furrow nutrition of 4 gal/A of Pro-Germinator + 6 gal/A of Sure-K and 2 qt/A of Micro 500 were applied with the planter row unit in-furrow tube for both treatments. A partial amount of the total recommended nitrogen, 3 gal/A, was added to the second treatment to make the comparison. The remaining recommended nitrogen needs were sidedressed 36 days after planting. Yield results of this test appear in the chart below.

Conclusions:

• A planter applied in-furrow application of Pro-Germinator, Sure-K and Micro 500 with High NRG-N sidedressed provided the highest yield.

• The addition of High NRG-N in-furrow at 3 gal/A caused over a 3 bu/A decrease in yield.

• The application of nitrogen in-furrow carries a high risk of stand reduction and is not recommended by Agro-Culture Liquid Fertilizer.

• The application of low rates of nitrogen solution to high rates of in-furrow fertilizer did not result in increased yield.

LSD (0.2): 4.3 CV: 7.6%
Objective:

Compare effects of an AgroLiquid corn fertilizer program that applies less than half the amount of nutrients per acre to two conventional fertilizer programs.

AgroLiquid fertilizers are touted as having nutrient formulations that are more efficient and longer lasting in the soil than are comparable conventional fertilizers. Such enhancements enable application of nutrients at reduced rates since said nutrients are not lost or made unavailable to the crop. Three different corn fertilizer programs were developed based on soil test and applied to plots in an experiment that keeps the same fertilizer programs in the same plots in a corn-soybean rotation. The conventional treatments applied a program of 180-30-120 compared to 147-8.5-3.8 for AgroLiquid. (Note: the conventional treatments had 200 lb/A of potash applied in the previous fall after soybean harvest. This is a common practice in the area and is to provide K to the corn and following soybean crops.) This is the third year of this experiment, and the yields from 2013 are in the chart.

Conclusions:

• All of the treatments increased yield over that of the nitrogen only treatment. This was the reduced rate of nitrogen used in the AgroLiquid treatment, applying 141 lb of N per acre.

• The AgroLiquid treatment produced the highest average yield compared the two conventional treatments that applied over twice the amount of nutrients per acre.

• In addition to higher yield, the in-furrow AgroLiquid treatment is easier to apply.
An objective is set to evaluate the effects of the same fertilizer programs in the same plots in a long-term corn-soybean rotation on corn yield. AgroLiquid crop nutrition programs are based upon usable plant nutrition, and not just total pounds of nutrients applied. Due to enhanced fertilizer usability, AgroLiquid application rates are much lower than those of conventional fertilizers. The ability to produce comparable yields has been well documented, but there is always concern on the sustainability of AgroLiquid programs over time. Previous research at the NCRS showed yield and soil test sustainability over a ten year test where the same programs were run in the same plots in a corn-soybean rotation. This experiment is set up to test the same fertilizer programs applied in the same plots in a corn-soybean rotation. 2013 marked the third year of a proposed ten year duration. This will enable evaluation of sustainability. Two conventional programs, one total dry and one liquid with potash were compared to an AgroLiquid program. The conventional programs applied a 180-30-60 for N-P2O5-K2O. (Although 120 lb/A of K2O is applied to last 2 years, as explained in table below.) The AgroLiquid treatment applied only 145-8.5-3.8 of N-P2O5-K2O for comparison. Additionally, a low-rate conventional treatment that nearly matched the AgroLiquid treatment for nutrients applied was also included for comparison. The yields for the three years thus far appear in the table below.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>3 yr avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 N only</td>
<td>195.5</td>
<td>189.8</td>
<td>195.1</td>
<td>193.5</td>
</tr>
<tr>
<td>2 Dry</td>
<td>202.4</td>
<td>196.4</td>
<td>208.4</td>
<td>202.4</td>
</tr>
<tr>
<td>3 Conventional liquid</td>
<td>207.7</td>
<td>197.1</td>
<td>207.1</td>
<td>204.0</td>
</tr>
<tr>
<td>4 Low rate conv. liquid</td>
<td>202.9</td>
<td>204.7</td>
<td>196.4</td>
<td>201.3</td>
</tr>
<tr>
<td>5 AgroLiquid</td>
<td>213.8</td>
<td>217.9</td>
<td>213.6</td>
<td>215.1</td>
</tr>
</tbody>
</table>

Conclusions:

- Highest yielding treatment each year was with AgroLiquid which applied less than half of the total nutrients per acre compared to the conventional treatments.
- The low-rate conventional also produced exceptionally high yields for the amount of nutrients applied. But this yield was substantially lower than that with AgroLiquid, even though nutrient application rate was the same.
- The low-rate conventional treatment actually yielded higher than the full-rate conventional treatments in 2012. But in 2013, the yield was much lower suggesting that this rate is not sustainable.
Objective:

Follow soil test levels as influenced by different fertility programs in the same plots in a corn-soybean rotation.

The yields for different corn and soybean fertilizer treatments have been discussed in this report for experiments 13-714 and 13-715. This section gives the nutrient soil test levels following corn harvest this year. There were 12 cores taken from each plot: 4 from in the row and 8 from between the rows. Soil from each plot was analyzed separately, and then the results were averaged for presentation in the table below. This experiment was started in its current design in 2011 with corn, followed by soybeans in 2012, and corn this year (2013). In the spring of 2010 when this experimental area was first used for research plots, a whole site soil sample was collected for analysis. Those results are shown below as a “starting” level.

Conclusions:

- After three growing seasons of this experiment, there were no appreciable differences in soil nutrient levels between the different fertilizer programs, including the unfertilized check treatment.
- It is observed that the phosphorus levels in particular are lower at the conclusion of the 2013 growing season than in the spring of 2010. The 2010 sample was a whole field sample, and perhaps a higher P area influenced the results. But more likely is the fact that the 2013 samples were collected following harvest removal of 200 bu/A, and the soil has not cycled through more P release.
- The lower rates of AgroLiquid fertilizers were able to provide higher corn and soybean yield than the conventional fertilizers without any negative effect on fall soil nutrient levels. So there is no “mining” as may be thought.
Objective:

Compare a corn nutrient program for AgroLiquid fertilizer against a conventional fertilizer program, both with equal application rates of N-P-K.

AgroLiquid fertility recommendations are applied at rates substantially lower than those of conventional programs, and yet are able to produce similar if not higher yields. This is due to enhanced nutrient formulations that enable nutrient preservation in the soil and increased uptake and usability. Additionally, they are typically less harmful to developing roots and subsequently plants have a larger root system that further enables more nutrient uptake. However, the question is sometimes asked about the effects of an equally reduced application rate of conventional fertilizers and the subsequent effect on yield compared to that of a full rate. An experiment was established to answer this question by applying reduced rates of potash, 10-34-0 and 28% UAN to compare to an AgroLiquid program. Both of the low-rate programs applied approximately 144 lb/A of N and 8 lb/A of phosphate. The potash was fall-applied after the soybean crop at a double rate to last for the corn and next soybean crop, hopefully. So the conventional program had 12 lb/A of K2O compared to 4 lb/A for AgroLiquid. A slightly higher rate was applied in the conventional to account for broadcast vs band. This is the third year of this comparison. The 2013 results appear below.

Conclusions:

- The low-rate AgroLiquid treatment produced a yield that was 17 bu/A greater than that produced with an equal nutrient rate of conventional fertilizers.
- The full rate of the conventional fertilizers resulted in an increased corn yield compared to that of the low rate, but was still lower than the yield with the AgroLiquid nutrition.
- Therefore, yield is affected by fertilizer type and not just rate.
Objective:

Evaluate the yield effects of the different AgroLiquid program components.

According to a soil test for 175 bu/A corn, a fertilizer program of 180-30-60-2 Zn was developed for this fertilizer component experiment. Following this, a planter fertilizer program of 3 gal/A Pro-Germinator, 5 gal/A Sure-K and 2 qt/A Micro 500 was made. To determine the importance of a complete fertilizer program and evaluate the value of each program component, two treatments were compared to the complete program. One treatment removed the Pro-Germinator from the program where the second removed the Sure-K. All treatments were applied in-furrow with a tube that placed fertilizer in the seed trench. Treatments were also all sidedressed with 47 gal/A 28% + eNhance, 30 days after planting. Treatment yields appear in the following chart.

Conclusions:

• All treatments including the nitrogen only, exceeded the 175 bu/A yield goal. The location of this experiment is a highly productive soil, and has historically produced high yielding corn and soybeans.

• The fertilizer program containing only Sure-K and Micro 500 yielded about 200 bu/A, 5 bu/A higher than the nitrogen only.

• The treatment with Pro-Germinator and Micro 500 increased corn yield nearly 15 bu/A over the nitrogen only treatment.

• Highest yield was achieved with the complete fertilizer program with a yield of over 213 bu/A. This verifies the importance of each fertilizer program component. In order to achieve top corn yield, all nutrients must be added to the program at the proper rates.
Objective:
Evaluate the long-term yield effects of the different AgroLiquid program components.

In the spring of 2011 a long-term study was developed to compare the influence of fertilizer components on overall fertilizer programs. A yield goal of 175 bu/A corn was established (However, actual corn yields have far exceeded the original goal.) Following a soil test, a recommendation of 180-30-60-2 Zn was developed. Three fertilizer treatments were developed and compared to a nitrogen only treatment.

1. 3 gal/A Pro-Germ. + 5 gal/A Sure-K + 2 qt/A Micro 500
2. 5 gal/A Sure-K + 2 qt/A Micro 500
3. 3 gal/A Pro-Germ. + 2 qt/A Micro 500

These treatments were applied in-furrow at planting and were all sidedressed with 47 gal/A 28% + eNhance. These treatments are part of the long-term “permanent” plot study, therefore all treatments remain in the same location from year to year. A summary of the first three years of yield results appear on the table below.

Fertilizer Program Components - 3 Year Average

<table>
<thead>
<tr>
<th>Fertilizer Program</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>3 Year Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Only</td>
<td>189.8</td>
<td>195.5</td>
<td>195.1</td>
<td>193.5</td>
</tr>
<tr>
<td>5 gal Sure-K + 2 qt Micro 500</td>
<td>211.1</td>
<td>195.8</td>
<td>199.9</td>
<td>202.3</td>
</tr>
<tr>
<td>3 gal Pro-Germ. + 2 qt Micro 500</td>
<td>213.4</td>
<td>205.6</td>
<td>209.4</td>
<td>209.3</td>
</tr>
<tr>
<td>3 gal Pro-Germ. + 5 gal Sure-K + 2 qt Micro 500</td>
<td>217.9</td>
<td>213.8</td>
<td>213.6</td>
<td>215.1</td>
</tr>
</tbody>
</table>

Notes: All treatments within each year were sidedressed with the same nitrogen program.

Conclusions:

- All treatments including the nitrogen only, exceeded the 175 bu/A yield goal. The location of this experiment is a highly productive soil, knowing the yield potential, recommendations may have changed. However, this being a long term study, rates will remain the same to compare changes in yield and soil test based on fertilizer programs.

- Of the planter fertilizer treatments, lowest yield average is the program containing just Sure-K and Micro 500, yielding almost 7 bu/A less than the Pro-Germinator only treatment.

- The treatment with Pro-Germinator and Micro 500 has a three year average yield increase of over 15 bu/A. Even in these higher phosphorus soils, there is great benefit to Pro-Germinator and Micro 500 applied in-furrow.

- Highest yield was achieved with the complete fertilizer program with a three year yield average of 215 bu/A, this is over a 20 bu/A yield increase over the nitrogen only treatment. This demonstrates the importance of a complete fertilizer program and its effects on corn yield.
Objective:

Compare different nitrogen source inputs for corn.

This experiment is intended to follow similar fertilizer programs over time in a corn/soybean rotation. Nitrogen recommendation of 180 lb/A was set to reach a yield goal of 175 bu/A. This is a very productive soil, where yields the past two seasons have exceeded expectations and 2013 was no different. Within this experiment were three different AgroLiquid nitrogen treatments that are actually applying much less than the 180 lb that is the standard for this test. The treatments were: 41 gal/A of High NRG-N (126 lb N/A), 47 gal/A of 28% with eNhance (141 lb of N/A) and 47 gal/A of 28% with 4 gal/A access (141 lb N/A). All treatments received the same planter fertilizer program to allow for comparison of N treatment effects. The yields appear in the following chart.

Nitrogen Source Comparison in Corn

Conclusions:

- Highest yield came from 28% + eNhance, which provided a yield of 213.6 bu/A. 28% + accesS provided the same amount of nitrogen per acre, however does not provide the same efficiency of nitrogen as 28% + eNhance, therefore was not able to provide the same yield response.

- Because the yield goal of 175 bu/A was exceeded, the lower actual rates of N in High NRG-N did not allow for above and beyond yield compared to the other N sources. However, excellent yield of 198.3 bu/A was reached.
Objective:

To evaluated planter applied sulfur options in corn.

Environmental air cleanup has greatly decreased the amount of free sulfur a corn crop receives each year. Because of this, growers should apply sulfur in order to research optimum yield. Agro-Culture Liquid Fertilizers has 3 sulfur options that can be used for planter applications. The first option is eNhance, which is 8.7% sulfur and also contains Manganese and Zinc. This product is safe for in-furrow applications on corn up to 3 qt/A. The other two options are accesS (17% sulfur) and S-Calate (14% sulfur). Neither of these products are recommended for in-furrow applications, but are safe for a 2x2 application. The difference between the two has to do with the soil requirements for calcium. In soils that have lower calcium levels, use S-Calate, as it contains 1% calcium.

This experiment compares an in-furrow fertilizer program with and without the addition of 2 qt/A eNhance and a 2x2 fertilizer program with and without the addition of 2 qt/A accesS. Yield results appear on the chart below.

Conclusions:

• Both sulfur sources, eNhance and accesS, increased yield over the comparable no-sulfur treatment. However, the yield increase with eNhance was statistically significant.

• There was no yield difference observed between the same fertilizer program applied in-furrow or 2x2.

• Highest yield was reached with an in-furrow application of 2 qt/A eNhance, with a 10 bu/A yield increase over the no sulfur treatment.

• It should be noted that current recommendations of accesS is closer to 2 gal/A. However, this experiment applied equal rates of both products for evaluation.
**Objective:**

To compare the application of Sure-K at a sidedress timing to a more standard planter in-furrow application.

Can an application of potassium be made at sidedress? The treatments were planted on May 3rd. Wet weather delayed sidedress applications to June 15th, 42 days after planting. Normally we would prefer to have sidedress completed by 30 days after planting. However, cool weather also delayed corn growth. The corn was at growth stage V5 and 12” tall at the time of sidedress. A rate of 7 gal/A of Sure-K was added to the 45 gal/A of High NRG-N, which was being applied as the nitrogen source, and coulter injected in the center of 30” rows.

**Conclusions:**

- It is still best to apply most of the potassium needs at planting to achieve optimum yields.
- In cases that arise where a late sidedress application is necessary, this test shows no significant yield decrease from the delayed application.
- Sidedress applications of potassium can still provide the nutrient needs, however not as effective.
Objective:
To observe the role that additional calcium provides when applied with a planter program in corn.

Calcium is an important nutrient to help facilitate the transport of other necessary nutrients for plant growth. If calcium in the soil is not in an available form, then additional available calcium applied in a narrow band with the planter can help to increase the effectiveness of other applied nutrients. To demonstrate this, an in-furrow application of 2.5 gal/A of Pro-Germinator + 2 qt/A of Micro 500 was made as a base comparison. A second treatment added 2 gal/A of LiberateCa to the base treatment. The last treatment added S-Calate to the 2x2 placement to avoid the higher sulfur content, in S-Calate, from being applied in-furrow.

Conclusions:
• The addition of LiberateCa provided the highest significant yield advantage over the base treatment of 2.5 gpa of Pro-Germinator and 2 qt/A of Micro 500.
• All treatments were significantly higher than the no planter fertilizer.
• The addition of either S-Calate or LiberateCa to the planter program provided a convenient source of calcium and both showed a yield response with their use.
Objective:
To compare in-furrow rates of Pro-Germinator in Corn.

Pro-Germinator is a highly effective nutrient product delivering both ortho and poly forms of phosphorus, giving plants an early and steady availability. An in-furrow band application provides nutrients where they are needed most. Pro-Germinator is balanced with nitrogen, potassium and micro nutrients for excellent performance. This experiment tested increasing rates of Pro-Germinator to see its results on corn yield. A no planter fertilizer treatment was used for comparison. Rates of 2.5, 3.5 and 4.5 gpa were used as treatments along with Micro 500 at a rate of 2 qt/A in each treatment. With the high soil test value of 24 ppm of P1, the recommendation for this would be 2.5 gpa in-furrow for a yield goal of 175 bu/A. Yield results appear in the chart below.

Conclusions:
• Growing conditions were very dry into the growing season as such, we did not reach our yield goal. But there was an increase in yield as the rate of Pro-Germinator was increased.
• All three rates of Pro-Germinator had a significant yield advantage over the no planter fertilizer treatment.
• Data confirms, along with past research, that even in higher phosphorus soils, there is a benefit of 3-4 gpa of Pro-Germinator planter applied.
• It is likely that the Pro-Germinator increased root volume that enabled better yield in the dry growing conditions.
Objective:
To compare different sources of nitrogen and additional additives on sidedressed corn yields.
In a corn following soybean rotation, applying nitrogen as a sidedress application within 30 days after planting is an excellent method to supply this nutrient. Sidedress can also be a great time to apply additional nutrients that may be needed. Agro-Culture Liquid Fertilizer’s eNhance can amend UAN solutions allowing lower rates to be applied while still achieving equal yields to full rates. eNhance allows for more efficient use of the nitrogen being applied. S-Calate also works with UAN solutions to improve the stability. Both products along with a pre-plant application of ammonium sulfate (AMS) were added to different rates of 28% UAN to observe their effects on yield. The lower rates of 28% + the additional products were compared to a full rate of 28%. Results appear below.

Conclusions:
• Due to extremely dry growing conditions, yields were considerably lower than planned.
• The additional calcium from S-Calate provided nearly a 10 bu/A yield increase over the 28% UAN only treatment.
• Using a lower rate of 51 gal/A of 28% and adding eNhance resulted in a sizeable increase in yield over the high rate of 28%.
• The commonly used AMS did not result in a yield increase over the straight UAN application. This may again be due to the dry conditions.
• Additional nutrients, that contain sulfur or calcium, to urea-ammonium nitrate (UAN) forms of nitrogen can increase yields while reducing the amount of nitrogen being applied.
Objective:
To compare planter fertilizer methods of application on yields in corn.

Typical methods of planter fertilizer applications have always involved placing nutrients into the soil profile. One application method referred to as 0x1 involves placing the nutrients in a narrow band on the soil surface and one inch to the side of the seed placement. This setup is very easy to install on a planter. It involves a stainless tube mounted behind the press wheels and your typical pump supply system. Some previous testing of 0x0 has been conducted at the NCRS in the past. This experiment is comparing the 0x1 placement to an in-furrow placement using the same nutrients and rates.

Conclusions:
• Very dry late season conditions resulted in lower than expected yields.
• The small 1 bu/A yield advantage of the in-furrow treatment over the 0x1 shows how close these placement methods are.
• The 0x1 treatment shows positive results as a viable option for nutrient placement. Continued testing will occur at the NCRS.

Experiment Info:
- Planted: 5/9
- Variety: P0216HR
- Population: 32,500
- Row Spacing: 30”
- Previous Crop: Soybeans
- Plot Size: 15’ x 800’
- Replications: 3
- Sidedress: 6/15
- Harvested: 10/23

Soil Test Values (ppm):
- pH: 6.8
- CEC: 9.7
- % OM: 1.9
- Bray P1: 8
- K: 77
- S: 10
- % K: 31
- % Mg: 22.3
- % Ca: 74.7
- % H: 0
- % Na: 1.0
- Zn: 0.8
- Mn: 5
- B: 0.5

Yield Goal: 175 bu
Target Fertilizer Rate: 192-75-20

Planter Fertilizer Methods of Application in Corn
North Central Research Station - 2013

<table>
<thead>
<tr>
<th>Yield - bu/A</th>
<th>120</th>
<th>125</th>
<th>130</th>
<th>135</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Planter Fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>126.7</td>
</tr>
<tr>
<td>5 gal Pro-Germ. + 5 gal Sure-K + 2 qt Micro (0x1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134.7</td>
</tr>
<tr>
<td>5 gal Pro-Germ. + 5 gal Sure-K + 2 qt Micro (IF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>135.8</td>
</tr>
</tbody>
</table>

Average of 3 Replications

LSD (0.2): 16.8    CV: 11.8%

All treatments sidedressed with 45 gal/A High NRG-N.
**Objective:**
To compare summary yields of ferti-Rain foliar applications on Corn.

Each year foliar applications are made to corn at the North Central Research Station to identify potential benefits from these treatments. ferti-Rain is a very well balanced nutritional source from Agro-Culture Liquid Fertilizer that is designed for foliar applications. It contains N, P and K as well as sulfur, iron, manganese and zinc to provide balanced plant nutrition. Foliar applications with ferti-Rain are safe because of its low salt index.

All applications were made with the Hagie high clearance sprayer at 10 gpa, 40-60 psi to provide uniform plant coverage and at temperatures below 80°F. Growth stages varied at time of application between V5 and VT. A summary of the average yields from experiments conducted between 2007 and 2013 appears in the table below.

### Summary of Corn Foliar Applications

<table>
<thead>
<tr>
<th>EXP #</th>
<th>Rate/A</th>
<th>Corn Stage</th>
<th>ferti-Rain</th>
<th>No Foliar</th>
<th>Yield Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-105</td>
<td>3 gal</td>
<td>V8</td>
<td>160.1</td>
<td>163.2</td>
<td>(3.1)</td>
</tr>
<tr>
<td>08-305</td>
<td>3 gal</td>
<td>V7</td>
<td>234.7</td>
<td>231.7</td>
<td>3.0</td>
</tr>
<tr>
<td>09-306</td>
<td>3 gal</td>
<td>V7</td>
<td>214</td>
<td>210.8</td>
<td>3.2</td>
</tr>
<tr>
<td>10-305</td>
<td>3 gal</td>
<td>V5</td>
<td>171.8</td>
<td>177.4</td>
<td>(5.6)</td>
</tr>
<tr>
<td>10-305</td>
<td>3 gal</td>
<td>VT</td>
<td>193.6</td>
<td>199</td>
<td>(5.4)</td>
</tr>
<tr>
<td>11-510</td>
<td>3 gal</td>
<td>V8</td>
<td>131.9</td>
<td>132.9</td>
<td>(1.0)</td>
</tr>
<tr>
<td>11-716</td>
<td>2 gal</td>
<td>V7</td>
<td>166.1</td>
<td>164.4</td>
<td>1.7</td>
</tr>
<tr>
<td>11-716</td>
<td>2 gal</td>
<td>VT</td>
<td>161.2</td>
<td>164.4</td>
<td>(3.2)</td>
</tr>
<tr>
<td>12-702</td>
<td>2 qt</td>
<td>V8</td>
<td>186.8</td>
<td>199.8</td>
<td>(13.0)</td>
</tr>
<tr>
<td>13-709</td>
<td>2 gal</td>
<td>V8</td>
<td>148.9</td>
<td>144.7</td>
<td>4.2</td>
</tr>
</tbody>
</table>
| **Average:** | | | **176.9** | **178.8** | **(1.9)** |}

**Conclusions:**
- For healthy corn, foliar applications of ferti-Rain have not shown consistent results.
- Concentrate on good planter time programs to maintain healthy, well-nourished corn.
- Foliar applications can show a benefit if a deficiency symptom is being corrected or deemed necessary to aid recovery following an adverse weather effect. (Note: do not make a foliar application to corn that is under drought stress.)
Objective:

To observe the effect of varying fertilizer rates and placement on yield of soybeans in 15” row spacing.

Treatments were planted into no-till corn stalks on May 16th with a Kinze planter equipped with interplant row units. The Kinze planter includes both in-furrow Totally Tubular and in-furrow Rebounder’s with split stream application. Totally Tubular places nutrients on the bottom of the seed trench before the seed is placed in the furrow. Rebounders place nutrients over the top of the seed and to either side with the split stream. Soil conditions were ideal at time of planting. Three fertilizer rates, 5 GPA, 7 GPA and 9 GPA, were used. Each rate consisted of 50% Pro-Germinator and 50% Sure-K and applied through either of the two application methods. A no planter fertilizer check was also included for comparisons.

Conclusions:

• The Rebounder with split stream applications and placement above the seed appears to be safer at higher rates.
• Yields were reduced when higher rates were applied through the Totally Tubular option. These reductions were not significant between rates.
• With good moisture Agro-Culture Liquid Fertilizer recommends: a maximum in-furrow nutrition of 3 gal/A for 30” rows and a maximum in-furrow nutrition of 7 gal/A for 15” rows.
**Objective:**

To compare nutrient programs when used in combination with and without manure applications. The North Central Research Station has applied dairy manure to areas of this particular field for 16 straight years. The crop for the previous 15 years has been continuous corn. The experiment is divided into 4 sections, 2 sections have no manure applied, 1 section receives a 20 ton/A application in the fall and the fourth section receives an application in the fall and spring for a 40 ton/A total. Fall applications are chisel plowed into the soil, while spring applications are applied to spring tilled soil and then tilled with a soil finisher for soil incorporation. Soil samples were taken again last fall to continually observe the changes in soil tests.

This year soybeans were planted on half of the treatment areas to observe manure applications and soil test nutrient levels on this crop. Nutrients were applied according to soil test recommendations with the no manure section needing the higher rates of nutrients.

**Conclusions:**

- Both manure application timings had a significant yield advantage over no manure.
- Phosphorus applications are not needed for soybeans with manure applications.
- Maintain accurate soil tests and follow recommendations for supplemental nutrients.
- Manure applications reduce the need for additional nutrients.
**Objective:**

To compare rate and placement options for potassium needs for 30’’ row Soybeans.

Placing nutrients in a band close to the seed has always been an efficient use of applied nutrients. When nutrient recommendations exceed in-furrow placement limits then other options are needed. Other options may include 2x2 or part of the total in-furrow and the remainder foliar applied. AgroLiquid has partnered with AgXcel to build a new experimental option to place part of the total nutrients needed in-furrow and the remainder placed behind the planter press wheels on top of the soil and one inch to either side of the seed (0x1). The “AgXcel” treatment placed 3 gal/A in-furrow (maximum allowed rate for 30’’ rows) and the remaining 7 gal/A on the soil surface. The AgXcel equipment uses orifices to split the nutrient stream into the two different required rates.

**Conclusions:**

- Drier than normal growing conditions limited yield.
- All three placement comparisons resulted in similar yields.
- The 2x2 placement is a very safe way to band apply large amount of nutrients with the planter in 30’’ rows.
- Sure-K placed on the soil surface with the AgXcel option showed a slight non-significant yield increase over 2x2 and in-furrow with foliar placement.
- Future work with AgXcel could provide a new option for planter nutrient placement.
Objective:

To evaluate different planter-applied Sure-K rates on soybean yield.

The analysis of Sure-K can be of concern to growers who are used to higher analysis products. However, the technology within Sure-K allows it to be more usable to the crop than other potassium sources. This is backed by years of research at the North Central Research Station that proves similar results. This experiment compared increasing rates of Sure-K from 3 gal/A to 12 gal/A to help determine what the most efficient rate is. The site for this experiment is low in potassium with 69 ppm and 1.8% base saturation and is a corn soybean rotation with the same rate comparison for each crop: 3, 6, 9 and 12 gal/A. See the 2012 Research Report of corn yields, 2013 soybean yield results appear on the chart below.

Conclusions:

• The addition of Sure-K increased soybean yield by over 4 bu/A.

• There was a slight yield advantage to foliar applied Sure-K over a planter program at the same rate per acre. This is similar to past research results.

• Highest yield was achieved with the 3 gal/A rate of Sure-K, no additional yield was reached when increasing the rate of Sure-K.

• Similarly, in 2012 maximum corn yield was achieved with the 6 gal/A rate of Sure-K.

• In both years the maximum yield was similar to the conventional potash treatment. This proves the performance of Sure-K and supports that the technology behind the product increases the efficiency making it more usable to the plant.

Sure-K Rate Comparison in Soybeans - 30" rows
North Central Research Station - 2013

- All Sure-K treatments also contained 2 qt/A Micro 500.

- application made the fall following soybean harvest

LSD (0.1): 4.7  CV: 6.7%
**Objective:**

To compare different nutritional sources as foliar applications on soybeans.

The application of foliar products should be based on a soil test need which, sometimes, is also to correct a deficiency symptom. The use of ferti-Rain, a well-balanced foliar nutrition, has shown very good results in previous years of testing at the NCRS. This experiment included a ferti-Rain only, ferti-Rain plus Protriastim (PTS), Pro-Germinator and Fase2 treatments. PTS is a protein cell carrier with a tri-alcohol growth stimulant that boosts the crops ability to store energy which can result in quicker maturity. Fase2 contains N, P and K however it is specifically designed to be foliar applied in orchard crops. So the Fase2 treatment is strictly an experiment. (Note: Due to the high soil test K, the usual soybean foliar Sure-K was not included here). The following table shows the results from this experiment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield - bu/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Foliar</td>
<td>46.2</td>
</tr>
<tr>
<td>2 gal ferti-Rain</td>
<td>50.2</td>
</tr>
<tr>
<td>2 gal ferti-Rain + 2 oz PTS</td>
<td>52.4</td>
</tr>
<tr>
<td>2 gal Pro-Germ.</td>
<td>53.0</td>
</tr>
<tr>
<td>2 gal Fase2</td>
<td>52.1</td>
</tr>
</tbody>
</table>

- **Comparison of Foliar Products**
  - **North Central Research Station - 2013**
  - **Average of 3 Replications**
  - **Applied on July 12th to R1 soybeans**
  - **LSD (0.2): 4.0  CV: 9.6%**

**Conclusions:**

- All foliar treatments provided a significant yield advantage over the no foliar treatment.
- Fase2, Pro-Germinator and Protriastim (PTS) all performed well and had a larger yield than ferti-Rain. This yield advantage was not significant.
- Foliar feeding soybeans can provide yield benefits. Choose your nutrients based on soil test needs.
Objective:
To compare fertilizer programs for effects on soybean yield in a long-term continuous corn/soybean rotation.

This year marks the third year in a long-term study comparing fertilizer programs in a corn/soybean rotation. Each fertilizer program remains “permanent” within the plot area and from year to year. This allows for evaluation of fertilizer effects from each program and the impact each has on soil test levels.

For the soybean part of this experiment there are four main fertility programs being compared to meet the yield goal of 60 bu/A: two Agro-Culture Liquid Fertilizers programs and two conventional programs. The first AgroLiquid program applied according to the soil test was 5 gal/A Sure-K with 1 qt/A Micro 500 applied in-furrow with Rebounder seed firmer with split fertilizer applicators. The second program was a foliar application 3 gal/A Sure-K with 1 qt/A MicroLink Manganese applied at the V4 stage of growth. Conventional programs were two rates of muriate of potash (0-0-62) applied in the fall following the previous soybean harvest in 2011. Two programs are being compared, the standard program according to soil test was applied at a rate of 200 lbs/A. A second program rate of 20 lbs/A was applied to match actual pounds of potassium provided by the Sure-K application. Yield results appear on the following chart.

Conclusions:
• All fertilizer programs increased soybean yield over that of the untreated check.
• The planter applied AgroLiquid program exceeded the yield goal with an average yield of 66.2 bu/A.
• Similar yield was achieved with both rates of potash, yielding 63 bu/A. It is expected that as this experiment continues, yield with the low rate of potash will not be sustainable.
• Highest yield was obtained with a foliar application of Sure-K and Manganese, which was significantly higher than any other treatment.

Yield Goal: 60 bu
Target Fertilizer Rate: 0-0-82
LSD (0.1): 3.0  CV: 7.9%

Soybean Fertilizer Programs in a Permanent Plot Rotation (13-714)
Objective:
To compare long-term yield response to soybean fertilizer programs.

For the past three years, four fertilizer programs and an untreated check have been compared in a permanent corn/soybean rotation. In both the corn and soybean years, each treatment remains in the same 15’ x 210’ plot within the experiment along with the same location from year to year. With this, comparisons can be made on long-term effects of fertilizer programs on crop yield along with observing changes in soil test levels. In the soybean part of this experiment fertilizer programs were set up to reach a yield goal of 60 bu/A. With soil test recommendation calling 0-0-82 for 60 bu/A soybeans, the following programs were set.

1. AgroLiquid planter program: 5 gal/A Sure-K + 1 qt/A Micro 500 applied in-furrow
2. AgroLiquid foliar program: 3 gal/A Sure-K +1 qt/A MicroLink Manganese (single application at V4)
3. Conventional program: 200 lbs/A 0-0-62 (fall following soybean harvest)
4. Low Rate Conventional program: 20 lbs/A 0-0-62 (fall following soybean harvest)

A three year average of soybean yields appears on the chart below.

Conclusions:
• All fertilizer programs increased soybean yield over the untreated check and greatly exceeded the set yield goal of 60 bu/A. (Note: Soybean yields in 2012 were exceptionally high)
• After three years of testing, there is little difference between the two rates of potash. In the first years the low rate of potash was yielding higher than the recommended, however, over time this program yield is not holding up. It is expected that in future years, that this program will begin to yield closer to the untreated check.
• After three years, the AgroLiquid programs are yielding over 7 bu/A higher than the untreated check.
• Both the planter and foliar applied AgroLiquid programs have similar 3 year average yields. This is consistent with what we have seen in previous long-term fertilizer program studies.
Objective:
To evaluate the advantages of a Sure-K foliar application on soybean yield.

Agro-Culture Liquid Fertilizers foliar program containing Sure-K has shown continuous yield response over the past year. However, many factors such as soil test levels, environmental conditions and timing play a role in yield response. In 2013 four experiments at the NCRS looked at the benefit of a foliar application of Sure-K compared to an untreated check. These yield results were also added into a long running summary from around the mid-west that compared the same treatments. With the four experiments from 2013, the summary now includes yield results from 150 experiments from the NCRS, contact research sites and grower’s fields in four different states. 2013 yield and summaries appear on the table below.

Conclusions:
- Soil test levels, weather conditions and other factors may influence yield response. Not every comparison shows a benefit.
- In 2013, there is a just over a 2 bu/A yield benefit to a Sure-K foliar application from the 4 locations. However, one location saw a loss, one was nearly even and one had a 10 bu/A increase so there was a lot of variability from one location to the next.
- 150 locations throughout the Midwest from 1997 to date has shown over a 4 bu/A yield increase with foliar applications of Sure-K.
Objective:
To evaluate topdress nitrogen sources for effects on winter wheat yield.

A nitrogen source comparison with sulfur additive experiment was conducted at the North Central Research Station. High NRG-N and 28% UAN were compared at recommended rates with the additions of sulfur sources: eNhance, accesS and S-Calate. An experimental fertilizer, NF-13, was also included. Yield results appear on the chart below.

Conclusions:
- There was no significant yield difference between the recommended rates of High NRG-N, 28% + eNhance and 28%.
- The addition of sulfur sources accesS and S-Calate to High NRG-N, did not provide additional yield benefit. High NRG-N already contains 1% sulfur, which may have been enough to meet the requirements for the crop.
- The experimental product NF-13 did provide a slight yield increase but statistically insignificant.
- Greatest yield was achieved with the addition of 2 gal/A access to 40 gal/A 28% UAN with a yield of nearly 87 bu/A
**Objective:**
To evaluate nitrogen programs for topdress applications on dryland winter wheat.

Farm 4 at the NCRS, is a non-irrigated farm with a gravel based soil with a lower CEC. This farm was used for large strip comparisons of 2 nitrogen fertilizer sources: 28 gal/A High NRG-N and 32 gal/A 28% + eNhance. Products were applied topdress in early spring just as the wheat was coming out of dormancy. A yield goal of 100 bu/A was set with topdress applications of the equivalent of 120 lbs of N/A. However, due excess rain and cool temperatures in April, yields were lower than expected. These conditions may have caused a loss in nitrogen. Results from this experiment appear on the chart below.

**Conclusions:**
- In this non-irrigated experiment, similar yield was achieved with both of the nitrogen sources reaching a wheat yield of around 77 bu/A.
- These results are consistent with what we see in the field. In dryland situations with average growing conditions, yields with High NRG-N are comparable to those achieved with 28% + eNhance.
Objective:

To evaluate the timing of High NRG-N topdress applications on soft red winter wheat yields.

A commonly asked question is will High NRG-N perform better if it is applied earlier than normal in a winter wheat topdress method of application? This question arises because of the unique N-release characteristics of High NRG-N. By using the normal application date of the first of April, there are still 90 days until the end of June to make use of all available nitrogen. This test was conducted to see if that timing of early April would meet the nitrogen needs of the winter wheat and also to acquire information if the early topdress timing would enhance yield. The yield results appear in the chart below.

Conclusions:

- The best time to topdress winter wheat is at dormancy break around early April in Michigan. This timing proved a significant yield advantage over an early or late application.
- A delay in topdress application significantly lowered the yield below the early and normal application timing.
- An early High NRG-N application did not prove to benefit wheat yield.

Soil Test Values (ppm):

- pH: 6.9
- CEC: 9.1
- % OM: 2.2
- Bicarb P: 27
- K: 63
- S: 9
- % K: 1.8
- % Mg: 17.2
- % Ca: 80.6
- % H: 0
- % Na: 0.4
- Zn: 1.2
- Mn: 8
- B: 0.6
Objective:

Comparison of phosphorus fertilizer method of application for effect on winter wheat yield.

How and where you place phosphorus fertilizer for wheat in not as critical as a corn crop. The combination of the seed and row spacing along with the root structure, allows greater flexibility in wheat and other small grains. In the Northern growing conditions of the NCRS there is not a lot of growth that takes place in the fall before the crop goes dormant. This experiment compares a preplant broadcast application, drill-applied, fall foliar application on 2" growth and a spring topdress treatment. The same fertilizer was applied at each timing and included 4.25 gal/A Pro-Germinator, 2 qt/A Micro 500 and 2 gal/A access. All treatments also received a spring topdress application of 28 gal/A High NGR-N. Yield results based on method of application appear on the chart below.

Conclusions:

• As seen in past testing at the NCRS, there is no statically significant difference between the four methods of application.

• With similar results seen amongst all treatments, growers have options on when they can apply their phosphorus in these northern climates. Areas with known low soil phosphorus levels where risk of deficiencies occur, apply nutrients in the fall in order to prevent stress to the crop.
Objective:
Long-term comparison of the methods of application on wheat yield.

Three years of testing at the NCRS has shown consistent results when it comes to method of application options for winter wheat. For comparison: preplant broadcast, drill applied, fall foliar on 2” growth and spring topdress were evaluated. Soils at the NCRS are in the mid to high levels for phosphorus, so limited inputs are required. This combined with the shortened fall growing season before dormancy provides more options for timing. Fertilizer programs and three year averages appear on the chart below.

Winter Wheat Fertilizer Method of Application Comparison: 3 Year Avg.
North Central Research Station - 2013

Conclusions:
- For three years in a row, the NCRS has shown there is little difference between placement options on winter wheat.
- Areas with more fall growing time and requirements of more phosphorus, it may be necessary to have nutrients on sooner to provide best yield results.
Objective:
To compare fertilizer program rates and sources for winter wheat.

Fall applied fertilizer programs have been researched for a number of years at the NCRS. Comparisons of a soil test program to a basic program of Pro-Germinator and Micro 500 have been tested the last 5 years to determine the importance of following a soil test. In this year’s experiment, a soil test program of 8.5 gal/A Pro-Germinator, 1 gal/A Sure-K, 2 qt/A Micro 500 and 2 gal/A access was compared to 4.25 gal/A Pro-Germinator with 2 qt/A Micro 500. These programs were also compared to a conventional fertilizer program of 10-34-0, ATS, Manganese and Zinc. Yield results appear on the chart below.

Conclusions:
• All fertilizer treatments increased wheat yield over the nitrogen only treatment.
• Although the soil test program did have a higher yield than the other fertilizer programs, it was not statistically significant. Similar treatments have been evaluated in the past at the NCRS with a 2 bu average yield advantage to the soil test program. In all cases, the additional fertilizer costs were not covered by the yield increase.
• The addition of access to the fertilizer program did not influence yield.
• The conventional program yielded similar to the other fertilizer programs.
Objective:
To compare broadcast Nitrogen sources on sugarbeets.

One of the major nutrient needs of sugarbeets is nitrogen. However, adding more nitrogen than is needed will encourage leaf growth and decrease sucrose content of the root. Nitrogen should be applied to achieve optimum canopy development for the beginning of the growing period. Then soil nitrogen levels should back off toward the end of the season to acquire the highest sucrose yield. Recoverable white sugar per acre (RWSA) is the term for sucrose yield and the major factor for quality payments to growers. In this experiment High NRG-N was compared to 28% UAN + eNhance and 28% UAN. The rates used were 28, 32 and 40 GPA respectively. Treatments were broadcast applied after planting.

Conclusions:
• No significant difference in yield was observed between the 4 comparisons.
• The higher amount of 28% UAN did have the lowest recoverable white sugar per acre. It has been seen in the past that higher nitrogen applications can result in less recoverable white sugar per acre possibly because of the excess nitrogen.
• High NRG-N and 28% UAN + eNhance can provide the same yield as higher rates of 28% alone while applying fewer pounds of nitrogen. Efficiency of the nutrients is the key to using less total pounds of N.
• A rate of 32 gal of 28% + eNhance provided the highest recoverable white sugar per acre.

Average of 4 Replications

<table>
<thead>
<tr>
<th>Treatment</th>
<th>RWSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Nitrogen</td>
<td>24.6</td>
</tr>
<tr>
<td>28 gal High N (70% rate)</td>
<td>9,954 lbs</td>
</tr>
<tr>
<td>32 gal 28% + eNhance (80% rate)</td>
<td>10,042 lbs</td>
</tr>
<tr>
<td>40 gal 28% + eNhance (100% rate)</td>
<td>9,964 lbs</td>
</tr>
<tr>
<td>40 gal 28%</td>
<td>9,529 lbs</td>
</tr>
</tbody>
</table>

- All treatments received: 2 gal Pro-Germ. + 10 gal Sure-K + 1 qt Micro 500 + 1 qt Mn (2x2)
- N fertilizers surface applied after planting.

LSD (0.05): 1.4    CV: 6.4%
Objective:

To compare different fertilizer programs on sugarbeets.

The North Central Research Station regularly conducts an experiment utilizing different fertilizer sources on sugarbeets. These experiments compare a recommended conventional fertilizer program to a complete AgroLiquid program. This year’s complete dry conventional program contained ESN urea as its nitrogen source. The remaining treatments all used High NRG-N which was broadcast applied after planting. Yield and sucrose samples were taken at harvest with results appearing in the table below. Recoverable white sugar per acre (RWSA) yields are also shown in the white box for treatments that had sugar analyzed.

### Sugarbeet Fertilizer Program Comparisons

<table>
<thead>
<tr>
<th>Target Fertilizer Rate</th>
<th>Yield Goal 30 Ton/A: 150-64-99</th>
</tr>
</thead>
<tbody>
<tr>
<td>High NRG-N Only</td>
<td>RWSA</td>
</tr>
<tr>
<td></td>
<td>Average of 4 Replications</td>
</tr>
<tr>
<td>ESN + DAP + Potash</td>
<td>9,655 lbs</td>
</tr>
<tr>
<td></td>
<td>32.5</td>
</tr>
<tr>
<td>284 lb + 140 lb + 160 lb*</td>
<td>10-34-0 15 gal</td>
</tr>
<tr>
<td></td>
<td>9,427 lbs</td>
</tr>
<tr>
<td></td>
<td>32.8</td>
</tr>
<tr>
<td>Pro-Germ. + Sure-K +</td>
<td>9,570 lbs</td>
</tr>
<tr>
<td>Micro 500</td>
<td>32.2</td>
</tr>
<tr>
<td>5 gal + 7 gal + 2 qt</td>
<td></td>
</tr>
<tr>
<td>Pro-Germ + Sure-K +</td>
<td></td>
</tr>
<tr>
<td>Micro 500 + eNhance</td>
<td></td>
</tr>
<tr>
<td>5 gal + 7 gal + 2 qt + 1 gal</td>
<td></td>
</tr>
</tbody>
</table>

*Broadcast applied
- Liquid products applied 2x2 at planting
- All liquid programs received 32 gal High NRG-N broadcast after planting.

### Conclusions:

- All programs yielded significantly higher tons than the nitrogen only check.
- The AgroLiquid programs exceeded the 30 Ton/A yield goal.
- All four programs yielded similarly with no significant difference in tonnage or sucrose yield.
- Although the recoverable white sugar per acre (RWSA) differs slightly between treatments, the AgroLiquid program produced the same amount of RWSA per ton of beet yield as the dry only treatments.

### Soil Test Values (ppm):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.9</td>
</tr>
<tr>
<td>CEC</td>
<td>9.5</td>
</tr>
<tr>
<td>% OM</td>
<td>2.1</td>
</tr>
<tr>
<td>Bray P1</td>
<td>10</td>
</tr>
<tr>
<td>K</td>
<td>112</td>
</tr>
<tr>
<td>S</td>
<td>7</td>
</tr>
<tr>
<td>% K</td>
<td>3.0</td>
</tr>
<tr>
<td>% Mg</td>
<td>19.5</td>
</tr>
<tr>
<td>% Ca</td>
<td>77.2</td>
</tr>
<tr>
<td>% H</td>
<td>0</td>
</tr>
<tr>
<td>% Na</td>
<td>0.3</td>
</tr>
<tr>
<td>Zn</td>
<td>1.5</td>
</tr>
<tr>
<td>Mn</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Yield Goal:

- 30 Ton

### Target Fertilizer Rate:

- 150-64-99
Objective:

To observe the comparison between a conventional dry program and a complete AgroLiquid program.

Long term averages are a great way to see how fertilizer programs affect yields. By averaging yield results over several years it takes into account different soil types that the experiments were conducted on and the different weather conditions that exist from year to year.

Each year all Agro-Culture Liquid Fertilizer programs placed phosphorus, potassium and micro nutrients in a 2x2 band with the planter. High NRG-N was used as the nitrogen source and applied as a surface broadcast after planting. Conventional programs placed phosphorus as DAP (dry spread) or 10-34-0 (2x2) and potassium as potash along with micro nutrients as a broadcast spread and tilled into the soil ahead of planting. Urea (applied the same as other dry materials) or 28% UAN (broadcast after planting) was used as the nitrogen source. All programs matched fertility needs of the test area for that particular year. The North Central Research Station uses a Gandy Orbit Air spreader to accurately spread dry materials across the entire 15’ plot width. (Note: Prior to 2007 the above planter 2x2 applications were applied 1 inch to the side of the seed and at an even depth.)

Conclusions:

• Over 9 years, there has been an average 1 Ton/A yield advantage using Agro-Culture Liquid Fertilizers compared to a conventional fertilizer program.

• AgroLiquid nutrients provide all of the necessary nutrition needed for a great sugarbeet crop.
Objective:
To determine if an early foliar application to Navy Beans has an advantage in 30” rows over a later application time.

Navy Beans have shown over the years in North Central Research Station testing that they respond very well to foliar applications of nutrients such as ferti-Rain which has a blend of primary, secondary and micro nutrients. These applications have typically been made at the flowering or vine stage. In 2012 an experiment, on 15” rows, testing earlier foliar applications showed an advantage at the three trifoliate when compared to the vine stage application. A repeat of that test was made on 30” rows for multiple years of data. All treatments received the same 2x2 planter applied nutrients. Foliar applications were made at the third trifoliate or the vine stage of the dry beans. Yield results are in the table below.

Conclusions:
• The earlier application of 2 gal/A of ferti-Rain at the third trifoliate stage had a small yield advantage over the later application.
• Either timing of a foliar application of ferti-Rain did improve yields over the standard planter applied program without a foliar application.
• A foliar application can be made between the third trifoliate and vine stage as needed with other crop protection products.