

## **Optimizing Winter Wheat Management**

### **Principal Investigator:**

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### **Purpose:**

The proposed research will focus on several aspects of winter wheat management. Higher prices for both wheat and crop inputs has led to the surfacing of several non-traditional alternative approaches to fertilizer management. This study will test some of the alternative products. It will also look at traditional products that might now be feasible or necessary because of higher crop yields and different tillage practices. The last aspect of this research will be to attempt development of methods of applying N fertilizer at seeding that require less expensive equipment than that presently being used. Studies designed to create a better understanding of water and N interactions in wheat will continue at the station.

### **Background:**

Winter wheat producers in South Dakota have traditionally applied their nitrogen needs in the late fall or in the early spring using surface broadcast techniques. This created several management issues. First of all it required a second trip. This trip is becoming more expensive as costs escalate. Second, the surface applied nitrogen was prone to loss through volatilization, runoff, or leaching depending on the time of application and soil and weather conditions. Placing the material in the soil in proximity to the plants at the time of seeding was not ideal because it stimulated excessive fall growth and made the potential for denitrification and leaching losses greater. The 2007 project dealt with these issues for winter wheat and was a re-orientation of parts of a larger project that have focused on wheat quality issues in spring wheat.

### **Progress in 2007**

The 2007 was quite conducive to winter wheat production in central South Dakota although it was still below normal in rainfall.

One technique investigated for the second time in 2007 was the use of slow-release (poly coated) urea. One brand is produced by Agrium and is known as ESN. This material limits release of urea because the fertilizer is covered with plastic that allows moisture to enter and dissolve some (but not all of the urea) every time there is a moisture event. Urea in the solid form inside the plastic is safe from loss.

Three studies were performed with this material on farmer fields in 2007. Two of these were at Gettysburg and one near Winner. In all cases, soil nitrate nitrogen tests were used to determine the N rate required (using SDSU recommendations) to produce a 60 bu/a crop. Each of the experiments then had a check (no N) and a high rate (150 percent of recommended) along with differing combinations of applications timing for ESN and standard urea.

The most comprehensive of these studies was near Winner. A table showing some of the results is below. These sites were used as test locations for ongoing work on using optical sensors to predict fertilizer response. Those data are being analyzed separately.

### Winner 2007 crop year

<b>Treatment</b>	<b>Yield</b>	<b>Protein</b>
<b>Check</b>	<b>34.9</b>	<b>10.9</b>
<b>50 lbs N/a as ESN Fall</b>	<b>50.5</b>	<b>11.2</b>
<b>50 lbs N/a as ESN Fall w/option</b>	<b>49.5</b>	<b>11.3</b>
<b>50 lbs N/a as a Fall ESN/Urea Blend</b>	<b>50.0</b>	<b>11.2</b>
<b>50 lbs N/a as Urea Fall</b>	<b>49.4</b>	<b>11.2</b>
<b>50 lbs N/a as ESN Spring</b>	<b>51.8</b>	<b>11.8</b>
<b>50 lbs N/a as a Spring ESN/Urea Blend</b>	<b>56.6</b>	<b>11.4</b>
<b>50 lbs N/a as Urea Spring</b>	<b>52.1</b>	<b>11.2</b>
<b>100 lbs N/a as ESN Fall</b>	<b>54.0</b>	<b>11.7</b>

This is a pretty straight-forward table of results. It obviously was necessary to apply at least 50 lbs of N/acre. The form of nitrogen and whether it was applied in the spring or fall did not matter in 2007. The relatively dry weather mitigated losses with fall applications.

The Potter County studies did not have as many treatments. All of these studies are being done “field-scale” using the producer’s equipment for fertilizer applications and seeding. This requires significant investment of time and resources on their part. Consequently, the number of treatments used is often limited to those that have the best chance of providing results.

The Holzwarth site had 43 lbs of Nitrate-N in a soil test. The Cronin Farms site had 29 lbs on Nitrate-N per acre. This resulted in nitrogen recommendations of 86 and 91 lbs of N per acre respectively. Both of these sites produced almost classic response curves to N fertilizer additions. Both sites used a check, a low rate, the recommended rate, and a rate in excess of the recommended. Yield and protein increased in both cases as the N rate increased to the recommended level.

The Holzwarth site continued to respond by adding both yield and protein when the fertilizer rate exceeded that recommended for a 60 bu/a yield goal. In this case the farmer should have increased his yield goal or, done as has been indicated with spring wheat, applied a bit more N later in the season when it was apparent that yield potential was greater. This is a difficult decision and one which we hope the optical sensor work (that has paralleled this project) will help to answer.

### Ralph Holzwarth 2007 Crop Year

<b>Treatment</b>	<b>Yield</b>	<b>Protein</b>
<b>Check</b>	<b>46.5</b>	<b>11.0</b>
<b>50 Lbs N/acre as ESN Fall</b>	<b>56.6</b>	<b>11.9</b>
<b>86 Lbs N/acre as ESN Fall</b>	<b>64.8</b>	<b>12.9</b>
<b>86 lbs N/acre as Urea Fall</b>	<b>66.6</b>	<b>12.7</b>
<b>129 lbs N/acre as ESN Fall</b>	<b>73.5</b>	<b>13.3</b>

The Cronin site had a very classic yield response curve. Higher yields were not attained by N rates that exceeded those associated with a 60 bu/acre yield goal.

### **Cronin Farms 2007 Crop Year**

<b>Treatment</b>	<b>Yield</b>	<b>Protein</b>
<b>Check</b>	<b>39.7</b>	<b>11.3</b>
<b>50 lbs N/a as ESN</b>	<b>54.6</b>	<b>11.3</b>
<b>91 lbs N/a as Urea</b>	<b>60.8</b>	<b>12.4</b>
<b>91 lbs N/a as ESN</b>	<b>58.8</b>	<b>11.8</b>
<b>91 lbs N/a as Urea/w option</b>	<b>58.9</b>	<b>12.3</b>
<b>136 lbs N/a as ESN</b>	<b>57.4</b>	<b>12.5</b>

None of the producers chose to use stream bars to apply later season N in order to improve protein. This has commonly been thought of as a technique designed for spring wheat. There is a possibility that it may have significant applicability in winter wheat if protein content becomes an issue. **It is clear that the SDSU calibration curves were spot on in 2007.**

The fate of the N applied in 2006 was followed in 2007. These data are “still in the laboratory” along with much of the data from two water variable studies at the main station. Turnover in staff has impacted this aspect of the project.

#### **Plans for 2008**

The work with winter wheat and fall fertilizer application has (ESN or otherwise) shifted a bit to the area of equipment design. Presently, seeding time applications are being applied with separate mid-row banding openers. These have an advantage of placing the material the maximum distance from the seed row so that it is not available too early. This has disadvantages in that it makes the seeder more expensive, heavier, and harder to pull. Fertilizer could be placed closer to the seed if products like ESN are used. This might allow simplification of the seeder. Some ideas for doing this are being designed and will be tested this fall. If they prove feasible, it might mean N-use efficiency can be gained with much less expense.

In no-till systems, sulfur begins to cycle almost exclusively in the organic matter. This can sometimes lead to deficiencies developing during periods of cool weather in the spring. Even though the amount of sulfur in the system is adequate, cool weather keeps it from cycling in time. Applications of sulfate sulfur, zinc, and copper will be tested as part of the fertilizer program.

New products that are designed to enhance the ability of the plant to take up soil phosphorus (Jump-Start) or aim to keep fertilizer phosphorus “available” for longer (Avail) will be tested (most likely in cooperation with farmers).

The winter wheat line-source study will be included again this year. This documents the response of wheat to both water and nitrogen gradients and is being used to obtain benchmark optical and mass

spectroscopy data. This is essentially a repeat of the last two years line-source and should be the last year for this type of work.

A second water type study is following the spring wheat water by nitrogen study through a second year to test how well the residual N can be used. Last year's study had Briggs and Russ spring wheat along with various N rate treatments applied across a water gradient applied using the lateral move irrigator. Winter wheat was seeded uniformly into the resulting stubble last fall (following a cover-crop). A uniform rate of N was applied as ESN last fall. The field has been intensely sampled and will be uniformly irrigated. Each treatment from last year will be evaluated for its impact on this year's wheat.