



# Current Report

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## Applying Nitrogen-Rich Strips

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A crop's demand for fertilizer nitrogen varies annually, even in long-term plots where the same fertilizer nitrogen (N) rates are applied each year. Long-term soil fertility experiments at Lahoma have revealed the average N fertilizer requirement for wheat is 2 lbs. N/bu. However, examining individual years reveals a wide range in the response of wheat grain yield to N fertilizer. Figure 1 shows the difference in yield between check plots that have not received any N since the trial was established more than 40 years ago, and plots that have received 100 lbs. of N every year. In 1973, 1979, 1983 and 2001, the non-fertilized plots produced the same yields as those fertilized. In years when no fertilizer response was observed, the yields ranged between 28 bu ac<sup>-1</sup> and 40 bu ac<sup>-1</sup>. In comparison, nitrogen fertilizer increased yields by 35 bu ac<sup>-1</sup> or more in 1988, 1997, 2003, 2004, 2008, 2009 and 2012. The average yield of the fertilized plots during those seven N-response-years was 69 bu ac<sup>-1</sup>.

Where did the N come from in the years where the non-fertilized plots did as well as plots that had been fertilized yearly for nearly 40 years? The answer is N mineralization via an extremely wet and warm winter-spring. When winters are wet and warm, sufficient N can be mineralized from soil

organic matter to meet the demands for high grain yield. In addition to this mineralization, wet years have more N deposition from rainfall. Our long-term winter wheat data confirm that the demand for N varies from year to year and wheat grain yield response to nitrogen fertilizer is unpredictable at the time when pre-plant N is being applied.

If the optimal nitrogen fertilization rate changes each year, how can a farmer accurately calculate the correct amount of nitrogen fertilizer to apply? Soil testing (NH<sub>4</sub>-N and NO<sub>3</sub>-N) works well, but a pre-plant soil test does not give you all the information you need to make the most precise mid-season N rate decision. Soil testing is necessary to check the soil pH and the availability of other macronutrients such as phosphorus and potassium. Basing nitrogen fertilization practices on a pre-plant soil test, however, still requires the producer to make fertility decisions with little knowledge of crop yield potential or N mineralization. For precisely this reason, Oklahoma State University has developed methods that account for the influence of year to year variability for N needs. By using a nitrogen rich strip, better fertilizer N decisions can be made mid-season when the growing crop can tell us precisely how much N was delivered for free and how much more will be needed.

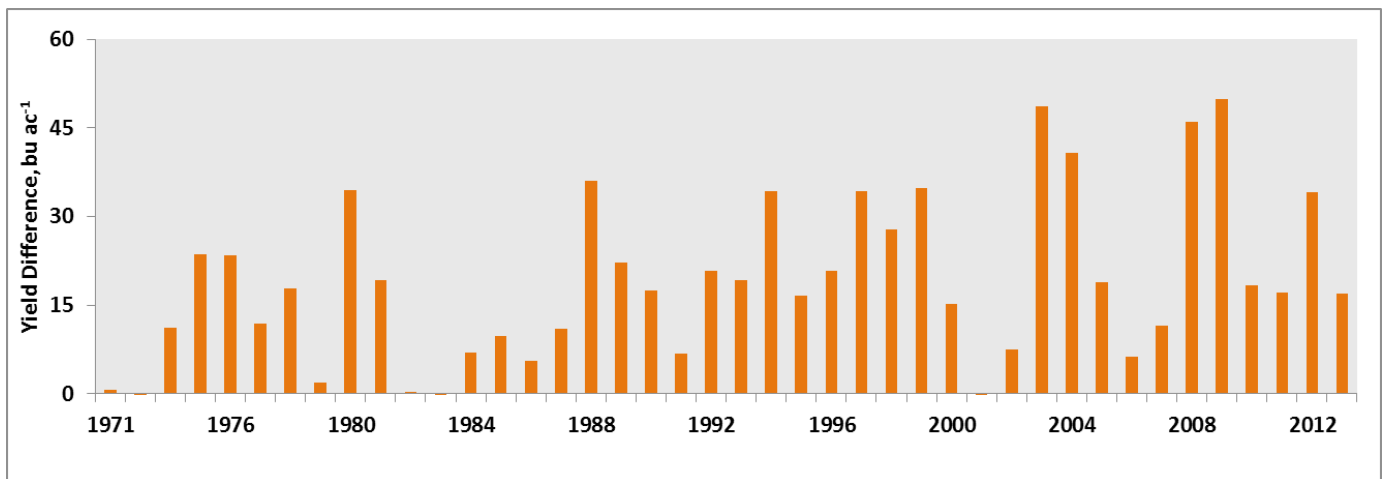


Figure 1. Wheat grain yield difference between plots that received 100 lbs N per acre every year and the 0-N check. Data from the 502 long term fertility study, which was established in 1971, located at the North Central Research Station near Lahoma, OK.

## What are N-Rich Strips?

The N-Rich Strip is an area in the field that has received enough fertilizer N, regardless of the environmental conditions, N will not be deficient during the growing season. The rest of the field receiving the standard pre-plant rate is called the Farmers Practice. The N-Rich strip is used in conjunction with the GreenSeeker™ hand held sensor to determine mid-season N rates. N Rich strips are of value in any field crop.

## How are N-Rich Strips used?

The most basic use of the N-Rich strip is as a 'Yes' or 'No' indicator. Which is just how it sounds, when you look at a reference strip if you can see the strip, it means YES the field needs N, if however the reference strip is not visible, NO this field does not need extra N fertilizer. Using the N-Rich strip in this way does not give you an N rate recommendation, just whether or not N is needed; to get an N rate recommendation from an N-Rich Strip a GreenSeeker™ sensor must be used.

To obtain the most accurate rate from any reference strip, a sensor is needed. The GreenSeeker™ sensor measures normalized difference vegetative index (NDVI), which is calculated from the reflected light collected by the sensor. NDVI is a value providing a highly accurate estimate of plant biomass; as a result yield potential can be predicted mid-season using both sensor and some known climatic data from planting to sensing. By knowing the yield potential of the reference strip and the yield potential of the rest of a field, the N rate can be calculated. For example, if a reference strip is sensed, and yield potential is estimated at 50 bu ac<sup>-1</sup> and the rest of the field has an estimated yield potential of 30 bu ac<sup>-1</sup>, then enough N should be added to make up the 20 bushel difference. Using the rule of thumb of 2 lbs. N ac<sup>-1</sup> bu<sup>-1</sup>, the recommended N rate would be 40 lbs. of N ac<sup>-1</sup>. This is all accomplished using an algorithm developed for each specific crop. The algorithm embodies calculations used to mathematically predict yield potential and determine a fertilizer N rate. For a more in-depth discussion of the algorithms read the "Optical Sensor Based Algorithm" article at [http://nue.okstate.edu/Index\\_NFOA.htm](http://nue.okstate.edu/Index_NFOA.htm).

## Why Apply N-Rich Strips?

A perfect example of why everyone should apply N reference strips was the 2006-07 wheat production year. Many acres were abandoned because of wet weather that prevented the harvesting of what promised to be a bumper crop. The question then presented itself: How much N is going to be supplied by residue incorporated back into the soil? Dependent upon yield of the last year's crop and concurrent environmental conditions, this value could vary substantially. A soil test gives a very accurate determination of the amount of N available at the exact moment of sampling. However, if fertilizer decisions are made from a pre-plant soil test, there is no accurate way to estimate the amount of N either mineralized or immobilized during the winter period. The only way to know how much N was made available between planting and time of top-dress would be use of a reference strip.

Other situations where reference strips offer even greater benefit is in the adoption of no-till and when rotating after a legume. The reference strips provide information on the amount of N that the environment (mineralized from soil organic matter and/or deposited in the rainfall) provides. Nitrogen reference strips also say a lot about the environment, as in years of high production the reference strips will likely indicate the need for more N, and indicate the need for less N in years where growing conditions are poor.

On-farm, sensor-based N studies in 15 wheat fields in Oklahoma showed an average savings of 20 lbs. of N ac<sup>-1</sup>, and resulted in an N rate application lower than the farmer's traditional rate 60 percent of the time, and a higher application 40 percent of the time.

## Applying N-Rich Strips:

### How

The N-Rich strip is the easiest reference strip to apply. It can simply be made by a double or triple pass of the applicator when pre-plant N is being applied.

### When

The application of the reference strips should take place when pre-plant fertilizer is applied, during or soon or soon after planting. For summer crops, it is critical to create reference strips at the recommended time. For winter wheat, the placement of the strips can be delayed for up to one month after sowing. Most N-rich strips, because of their larger size, can take a light tillage pass.

### Where and How Big

One strip is recommended in every field, every year. And it is best to change the location of the strip every year. It is more important to keep good records on where the strips are located each year. The best case scenario is placing strips in each management or yield zone of the field. This way, an N rate can be prescribed for each zone. It is recommended that the N-Rich strip be at least 10 feet wide and 300 feet long. It is common for the strips to be much wider and go the length of the field.

### How Much N

The amount of N used in the N-Rich Strip is related to the crop. Table 1 below shows the minimum amount of nitrogen suggested both for the field and the N-Rich Strip. The minimum N-Rich Strip rate is the amount of N more than the rest of the field is receiving. For example if the producer is applying 25 lbs N ac<sup>-1</sup> to the field, the N-Rich strip should receive at least 75 lbs N ac<sup>-1</sup> total.

For the N-Rich Strip to be effective in a timely manner, the Farmers Practice rate should not exceed 50 percent of the yield goal recommended rate. The N-source used is dependent upon the situation. Use the source most efficient and economical. One of the most efficient methods of applying N-Rich strips is to make a double or triple pass with the pre-plant N applicator.



**Figure 2. Equipment used for N-Rich Strips. From top-left to bottom right: Push spreader, ATV with 10-foot spray boom, receiver hitch mount with trigger in cab, dry fertilizer spreader, sprayer pull or self-propelled (often only use middle section) and anhydrous applicator.**

**Table 1. Minimum nitrogen rate recommendation for the Farmer Practice and N-Rich Strip.**

<i>Crop</i>	<i>Minimum total N level for FP <sup>*&amp;</sup> Lbs N ac<sup>-1</sup></i>	<i>Minimum rate for N-Rich Strip<sup>§</sup> Lbs N ac<sup>-1</sup></i>
Grain Only Wheat	25	50
Dual Purpose Wheat	50	50
Graze Out Wheat	50	100
Corn	50	75
Grain Sorghum	40	50
Forage Sorghum/corn silage	50	100
Bermudagrass	50	100

\* This value is equal to the residual NO<sub>3</sub> level + Preplant N + at Planting N.

§ This is the rate of N above the farmer practice.

& Under extremely dry conditions minimum total N level for FP could be reduced.

#### Other Sources of Information

[www.nue.okstate.edu](http://www.nue.okstate.edu)

[www.npk.okstate.edu](http://www.npk.okstate.edu)

[www.osunpk.com](http://www.osunpk.com)

PSS-2260 The History of the GreenSeeker Sensor.

PT 2005-3; Get your Nitrogen-Rich Strips out Early

PT 2003-12; “2 lb. Nitrogen/Bushel of Wheat” May Be Wrong

PT 2003-7; Developing and Using Nitrogen-Rich Strips

PT 2003-7; Managing Nitrogen Fertilizer for Spatial Variability in Wheat Fields

PT 2002-21; Managing Nitrogen Fertilizer Using a Nitrogen Rich Strip: Projected Profitability

Oklahoma Soil Fertility Handbook 2006;

Chapter 4. Determining Fertilizer needs

Chapter 12. The new nitrogen recommendation strategy

## **The Oklahoma Cooperative Extension Service**

### ***Bringing the University to You!***

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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