CROP EXCELLENCE®

Do Nitrogen Stabilizers Really Pay Off?

by John D. Bailey, PhD, and
Jim Thomas, Director Specialty Products

Nitrogen stabilizers have been studied for many, many years and there have been some improvements to our knowledge in how to use them to manage the risk of nitrogen loss.

Urease inhibitors have had positive effects on yield where rainfall around fertilizer application was less than 0.25 inches, which is not enough to move fertilizer into the soil. On the contrary, small amounts of rain (less than 0.25 inches) can actually cause more urea hydrolysis on the surface, and thus, promote loss. It is not uncommon in the scientific literature to see losses of 5%-30% of nitrogen from surface-applied urea and(or) UAN. I've personally ran trials in extreme conditions where the loss was closer to 50%...extremely detrimental to crop yields.

Nitrification inhibitors also can have a positive impact on yield especially when weather during the next four-six weeks after application includes moderately high volumes of rain that are well-distributed are coupled with high temperatures, especially on sandy soils. These conditions promote nitrification and leaching, where it is not uncommon to see estimates in the scientific literature from 5%-20% loss.

Independent research spanning several decades from both industry and universities shows that the effects of nitrogen stabilizers depend upon the formulation, the type and timing of application, and, above all else, the weather.

TYPES OF NITROGEN STABILIZERS

Nitrogen fertilizer stabilizers can be classified into three major types: Urease inhibitors, nitrification inhibitors, and slow-release, coated fertilizers.

- Urease inhibitors are compounds mixed with urea-based fertilizers to decrease the rate of urea hydrolysis by temporarily blocking the active site of a common soil enzyme called urease. Urease inhibitors are designed especially for urea-based fertilizers that are surface-applied with no planned incorporation. High-pH soils or soils with high-residue conditions, such as no-till, are especially prone to urea loss (crop residue contains high concentrations of urease). Urease inhibitors protect urea from being quickly hydrolyzed and potentially volatilized before it makes its way into the soil (mechanically or via more than 0.25 inch of rainfall or irrigation). Once under the surface, the nitrogen from urea is converted to a form (ammonium) that is better protected in the soil. In this regard, urease inhibitors often have their largest impact on reducing yield loss if the urea sits on the soil surface for the first five to ten days after fertilizer application, especially if the soil is in the process of drying. Peer-reviewed, independent studies have shown anywhere from 30-50% nitrogen loss under these conditions.

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TYPES OF NITROGEN STABILIZERS (Continued...)

- Nitrification inhibitors are compounds mixed with ammonium-forming N fertilizers to decrease the rate of transformation of ammonium (NH_4^+) to nitrate (NO_3^-). Both N forms are plant-available, but nitrate is prone to leaching and denitrification. Therefore, a straight nitrification inhibitor product would not be expected to protect against yield loss unless weather patterns favor the rapid conversion and leaching of the fertilizer in losses large enough that N becomes insufficient to meet crop needs.

- Slow-release coated fertilizers are conventional fertilizers like urea that are coated with sulfur, polymers or both. Release of fertilizer through coating is a function of coating characteristics affected by soil, water, and temperature. The coating technology can provide a gradual supply of N for the developing crop. Since soil and climatic conditions can dramatically alter the effectiveness of these coatings, and they are usually the most expensive technology to apply, caution with their use is highly advisable.

NITROGEN STABILIZERS ARE REALLY ABOUT MANAGING RISK

Since weather plays a major role in nitrogen loss, a nutrient management plan can help manage the risk of loss. Loss of nitrogen costs the farmer two times – once for the loss of the fertilizer itself and second for the loss of yield of the crop. This is particularly true for a crop like corn which cannot afford a bad day when it comes to nitrogen. While it is not easy to predict the weather or nitrogen loss in corn, it is pretty simple to see the problem.

SIGNS OF NITROGEN DEFICIENCY

The corn above is at the V10 growth stage and is displaying symptoms of nitrogen deficiency. This is easy to recognize with the inverted, V-shaped yellowing starting at the tip of the lower leaves and moving inward toward the stalk. Corn can display these symptoms when N supply is insufficient for multiple reasons, including fertilizer losses. Nitrogen is essential to plant growth and development. On average, 1.2 pounds of N is needed to produce one bushel of corn. Therefore, a 200 bushel per acre corn crop needs 240 pounds of N per acre. Nitrogen is always in high demand by a corn crop – it's usually the most limiting macronutrient – so, meeting this demand usually means we must apply N fertilizer – a lot of times, more than once. Under scenarios with high loss of N fertilizer, nitrogen use efficiency goes down and can reduce yields tremendously.

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One way to decrease the risk of nitrogen loss due to unpredictable weather is by using a nitrogen fertilizer stabilizer. The decision to use one can be complicated. This is because the decision to use one needs to be made before one knows how the effect weather will play out in any given season – farming is always a gamble! I can't stress enough that there are no silver bullets in farming and it's critical to understand your management practices, production environment, and the way various stabilizers work in order to select the most profitable strategy to reduce N losses, improve nitrogen use efficiency, and reduce the chance for disastrous financial results. However, to help readers understand the potential pay-back of using a nitrogen stabilizer, I chose to model 3 scenarios where we are supplying 100% of the crop's nitrogen needs up-front, using surface-applied urea with no plans to incorporate it. I then compared scenarios where the loss of nitrogen from unprotected urea was a conservative 10% at two different rates of **SERPENTINE®**. I then did the basic math of the costs of the fertilizer, stabilizer, loss of fertilizer, and loss of yield.

*Table 1. **SERPENTINE®** pay-back model with surface-applied urea.**

Stabilizer? (Yes/No)	Yield Goal (bu/acre)	Nitrogen Needed (lbs N/acre)	Urea Needed (lbs urea /acre)	Cost of Urea (USD/acre)	Rate of Stabilizer (fluid oz /ton)	Cost of Stabilizer at $220.00 gallon (USD/acre)	Total Cost of Fertilizer and Stabilizer (USD /acres)	Modeled Nitrogen Loss (lbs N/acre)	Cost of fertilizer loss plus cost of yield loss (USD/acre)	Maximum Potential Crop Value @ $5.00/bu	Net Revenue Change vs. Maximum Potential**
Yes (High Rate)	180 bu	216 lbs	470 lbs	$70.50/ acre	64	$8.72/acre	$79.22/acre	2.5% Loss (6.25 lbs/ac)	$0.94/acre + $17.25/acre	$900/ acre	$837.09/acre (-$62.91/acre)
Yes (High Rate)	200 bu	240 lbs	522 lbs	$78.30/ acre	64	$9.68/acre	$87.98/acre	2.5% Loss (13.5 lbs/ac)	$2.02/acre + $37.26/acre	$1000/ acre	$872.74/acre (-$127.26/acre)
Yes (High Rate)	300 bu	360 lbs	783 lbs	$117.45/ acre	64	$14.54/acre	$131.99/acre	2.5% Loss (19.5 lbs/ac)	$2.93/acre + $53.82 /acre	$1500/ acre	$1307.14/acre (-$192.86/acre)
Yes (Low Rate)	180 bu	216 lbs	470 lbs	$70.50/ acre	32	$4.36/acre	$74.86/acre	5% Loss (13.5 lbs/ac)	$2.02/acre + $37.26/acre	$900/ acre	$785.86/acre (-$114.14/acre)
Yes (Low Rate)	200 bu	240 lbs	522 lbs	$78.30/ acre	32	$4.84/acre	$83.14/acre	5% Loss (26.1 lbs/ac)	$3.91/acre + $72.04/acre	$1000 /acre	$840.91/acre (-$159.09/acre)
Yes (Low Rate)	300 bu	360 lbs	783 lbs	$117.45/ acre	32	$7.27/acre	$124.72/acre	5% Loss (39 lbs/ac)	$5.85/acre + $107.64 /acre	$1500/ acre	$1261.79/acre (-$238.21/acre)
No	180 bu	216 lbs	470 lbs	$70.50/ acre	0	$0/acre	$70.50/acre	10% Loss (47 lbs Urea)	$7.05/acre + $129.72/acre	$900/ acre	$692.73/acre (-$207.27/acre)
No	200 bu	240 lbs	522 lbs	$78.30/ acre	0	$0/acre	$78.30/acre	10% Loss (52 lbs Urea)	$7.80/ac + $143.52/acre	$1000/ acre	$770.38/acre (-229.62/acre)
No	300 bu	360 lbs	783 lbs	$117.45/ acre	0	$0/acre	$117.45/acre	10% Loss (78 lbs Urea)	$11.70/ac + $215.28/acre	$1500/ acre	$1155.57/acre (-$344.43/acre)

*Model Assumptions: Urea Price = $300/ton, New Crop Corn Price – basis = $5.00/bu, maximum nitrogen loss from untreated urea = 10% and 1 lb Nitrogen = 1 bu/ac of corn. The payback model also assumes that doubling the amount of stabilizer will also doube the nitrogen protection.
**Net Revenue does not take into account any other production costs such as seed, harvest costs, grain hauling costs, etc.

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The **SERPENTINE®** payback model shows a few interesting things that I hope are useful to Crop Excellence® customers:

1. Do the fertilizer math! Knowing how much the fertilizer and stabilizer costs to apply is one thing... famers need to know that...but don't spend too much time worried about that. I'd rather see them worry about how much money they might lose by NOT protecting their nitrogen. For example, in the scenario above of no stabilizer used with a yield goal of 300 bu/acre corn, if 10% of the urea is lost, the farmers stands to lose almost $350.00/acre. That might sound exaggerated, but, remember - one must consider the loss of not only the fertilizer but also the loss of yield potential – for every 1 lb of nitrogen lost, it's about 1.2 bu/acre of corn lost. I don't know a single farmer in America that could afford that kind of risk. By using **SERPENTINE®** and modeling a conservative estimate of 50% reduction in nitrogen loss, the farmer saves more than a $100.00 acre.

2. By NOT protecting surface-applied urea, the risk of monetary loss is especially high as yield goals increase because application rates of urea will also increase.

3. The payback model also shows that it may be financially beneficial to use the higher rate of **SERPENTINE®** because the risk of loss of the fertilizer and the lost yield that occurs with the loss of nitrogen costs far more than the additional cost of doubling the fertilizer + stabilizer.

SUMMARY

When it comes to nitrogen stabilizer use, here are a few common-sense recommendations:

- N fertilizer stabilizer use will only have a positive impact on yield if weather conditions are conducive to N loss and those losses are to the point of N becoming limited in relation to crop demand.

- Urease inhibitors are more likely to have a positive impact on yield when urea-based fertilizer is surface-applied on high-pH (more than 7), and low-cation-exchange-capacity soil with high residue cover, where no incorporation (mechanical or rainfall) occurs in the first five days after application on a drying soil.

- Nitrification inhibitors may increase yield when used with non-Urea, ammonium-type fertilizers. This seems especially true for irrigated fields and(or) in fields where nitrate-N leaching commonly occurs.

- A combination product like **SERPENTINE®**, which mixes urease inhibitor with nitrification inhibitor offers more protection above and below the ground.

In closing, this article's title begs the question, "Do nitrogen stabilizers REALLY pay off?". Questions about the cost of inputs are probably the most common question I've been asked by retailers and farmers alike. After almost 20 years of doing agricultural research, my advice to them is to focus on more than just price. For example, rather than focusing on "How much does **SERPENTINE®** cost?", I recommend farmers spend more time asking, "How much money am I losing by not using a nitrogen stabilizer". In this regard, the answer is pretty clear.